WATER WORKS & SEWERAGE

L. H. ENSLOW, Editor

Vol. LXXIX, No. 5

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LEADING ARTICLES To Appear in the Next and Subsequent Issues:

During the past year the Indianapolis Water Co. of Indianapolis, Ind., has been making studies of pressure losses in customers' services. The investigation brought out much interesting information which is summarized by H. W. Niemeyer and J. A. Bruhn in an article to appear shortly.

Complaints regarding odor and pollution conditions caused by two old sewage disposal plants forced the town of Easton, Md., to take steps to abate these nuisances. How successful results were secured by direct feed chlorination of the sewage will be described by E. G. Kastenhuber in a forthcoming issue.

Small water companies with limited earnings present a perplexing problem to the engineer called in to correct operating difficulties. How this problem was solved for one company will be told next month by George H. Buck, consulting engineer.

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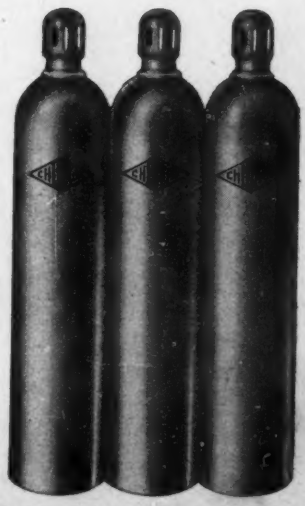

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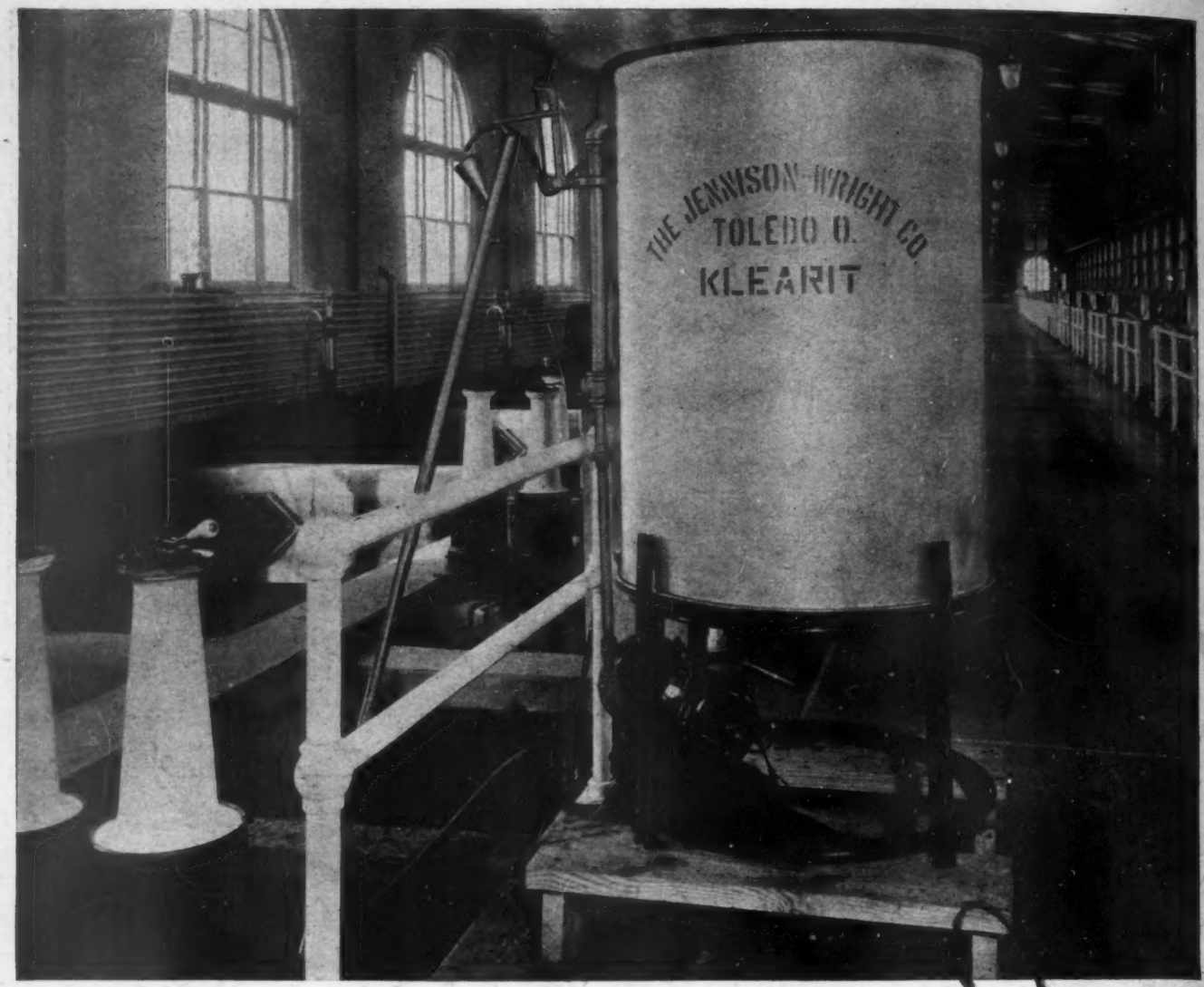

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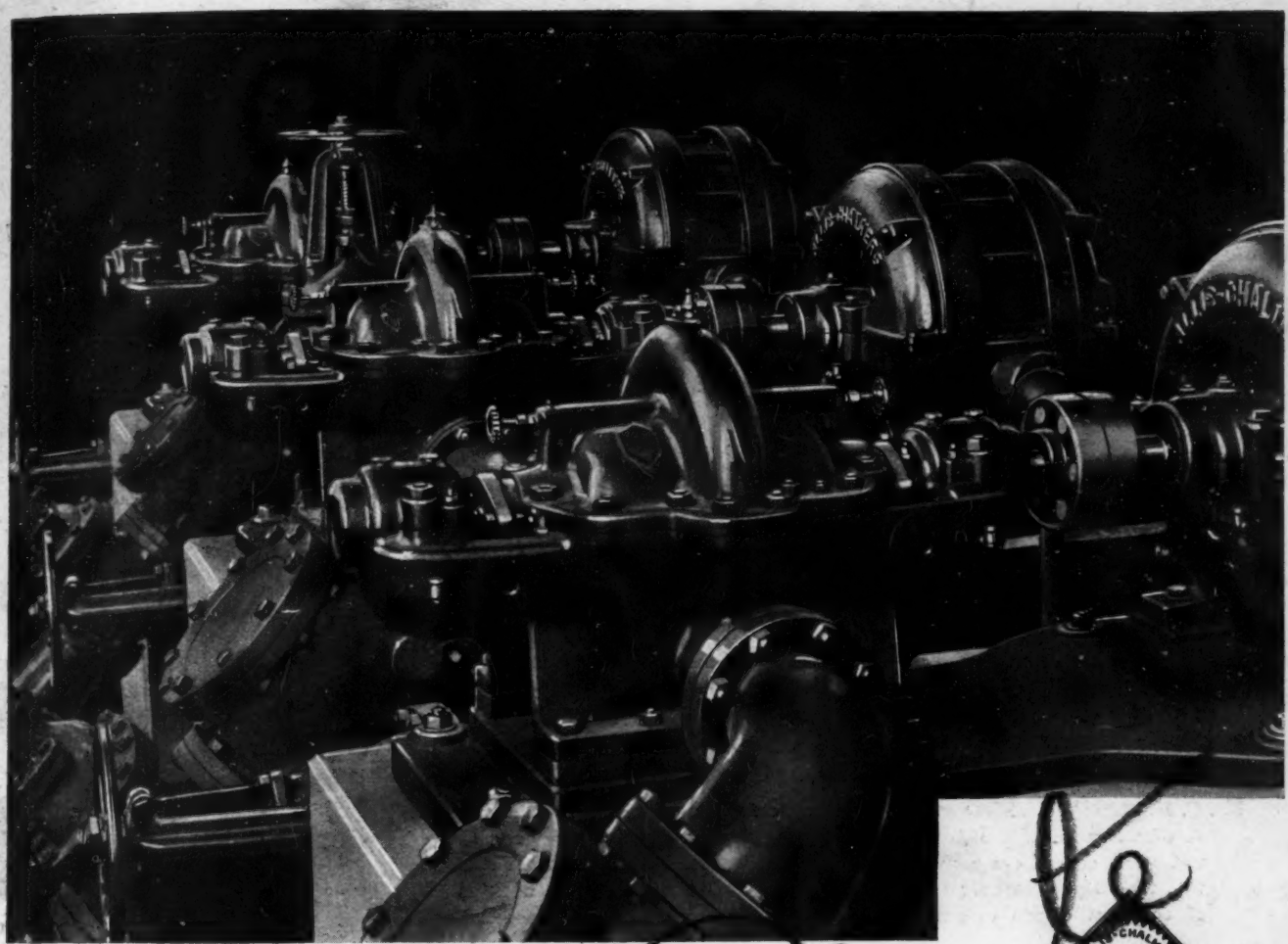

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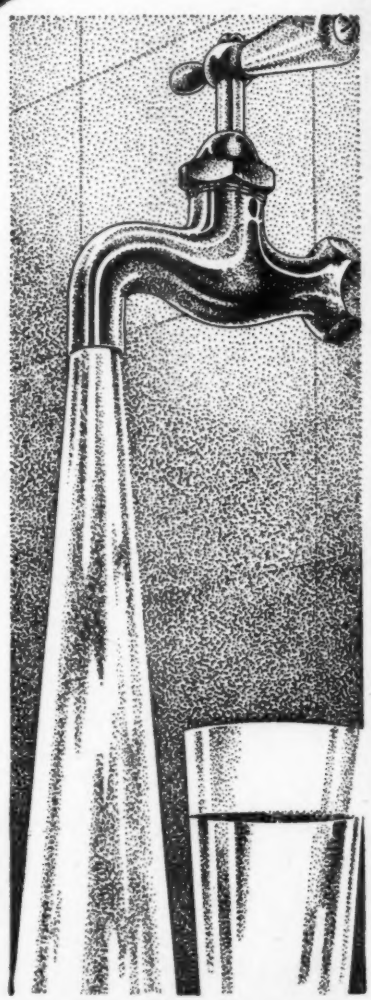

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WATER WORKS AND SEWERAGE

MAY 1932

VOL. 79 No. 5

A GILLETTE PUBLICATION

HIGH-LIGHTS OF SEWAGE TREATMENT IN EUROPE

By EDMUND B. BESSELIEVRE

Sanitary Engineer,
The Dorr Company, Inc.

(PART I)

E. B. Besselievre

IN the course of four months' passage through seven countries in Europe so much of interest to a "sanitarian" can be seen that it is manifestly impossible to cover it all even in the scope of two articles, of which this is the first. Consequently, in these articles it will be my endeavor to describe those things which I believe are outstanding and which tend to show the modern trend in European sewage plant practice.

Naturally, due to the earlier start made in England and Germany, these two countries are still in the lead in Europe, both in numbers of plants in operation and in their adoption of the more modern theories and proven practices. In view of the curtailed space allotted to me, I will restrict myself mainly to "things I saw" in those two countries which will interest us in "America." No attempt will be made to list all of the newer construction or to go into details regarding it.

One of the most impressive steps in sewage plant practice, both in England and Germany, is the progress in the utilization of gas from sludge digestion tanks, not only for the provision of heat for maintaining the optimum temperature of digestion, but also for the development of power. To my mind the installation of gas engines at the Saltley Works at Birmingham, England, which have been operating over a period of four years, providing all the electric current required to run the numerous mechanical units in the plant, is a wonderful demonstration of the possibilities of economical operation of sewage plants by power produced from gas. The cost of upkeep of these engines has been remarkably small, and when it is considered that there is sufficient gas obtained from the type of digestion tank in use at Birmingham to produce all of the power required around the plant, without the use of a gasometer, and that this has continued uninterruptedly for years, it is worth looking into. At the Birmingham plant there are three engines of a British make, two with a rated output of 400 hp. each and one (the first one, installed in 1927), with 150 hp. These engines are guaranteed by the makers to produce one horsepower hour for each 20 cu. ft. of digester gas having a B. T. U. value of not less than 625 per cu. ft. According to published data*, the total daily amount of gas being obtained from the digesters at Birmingham is 151,000 cu. ft., which, therefore, has a potential value of 7,500 hp. hours. The cooling water from the engines is discharged into the cooling ponds and no gas is utilized for heating purposes.

At Motherwell, Scotland, is to be found one of the latest plants to be put under construction utilizing all of the modern ideas with which we are familiar in this country. Incorporated in this plant are: Mechanical bar screens, detritors, mechanically-cleaned sedimenta-

*The Works of the Birmingham, Tame & Rea District Drainage Board Booklet—Feb. 1931.

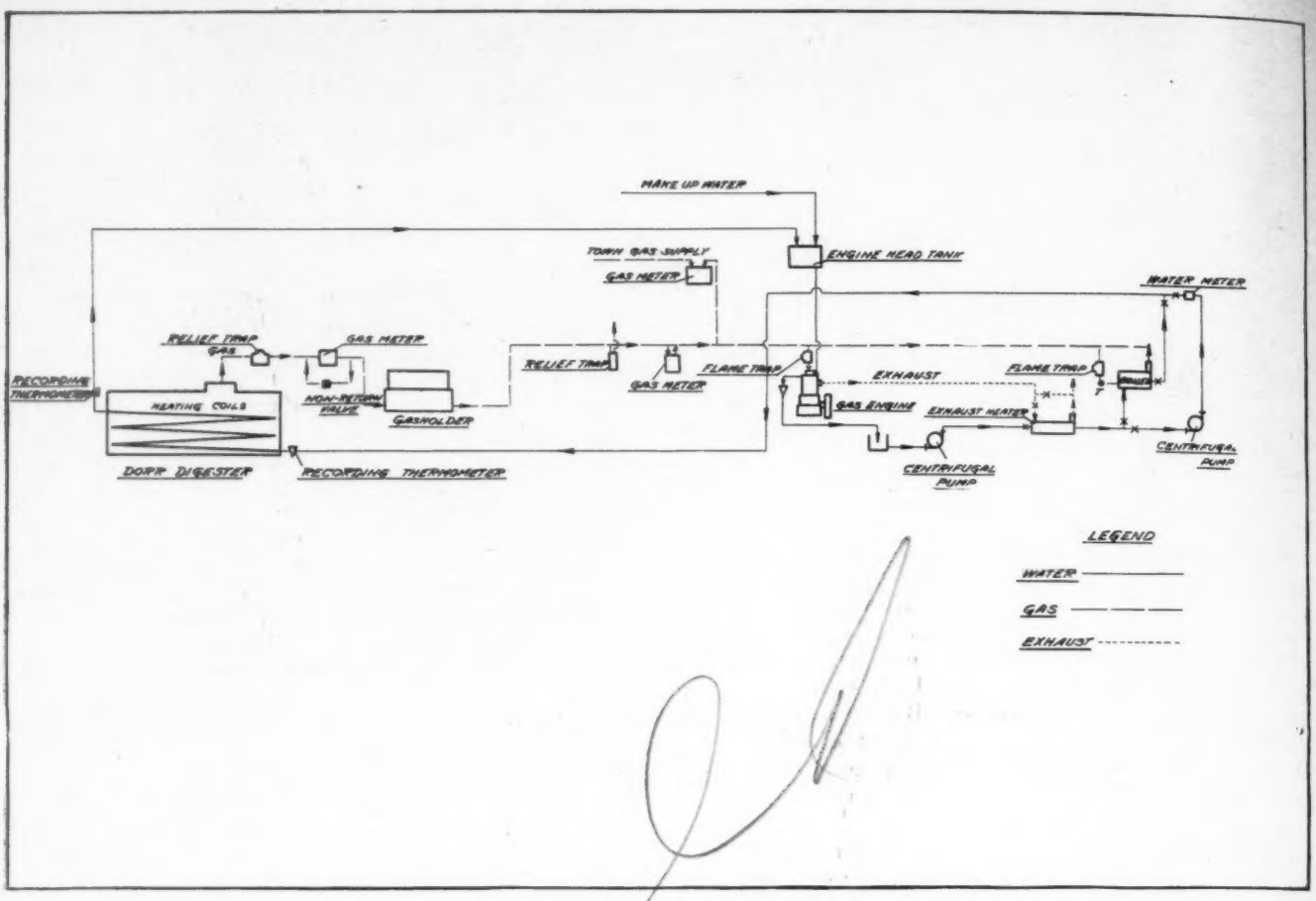

Fig. 1—Layout of Arrangement for Utilization of Sewage Gas at Plant at Motherwell, Scotland

tion units, aeration by means of the combination of paddles and diffused air, and final mechanial sedimentation. Digestion of the waste sludges from both the primary and secondary steps is effected in the gas collection type of digesters, and gas will be piped directly to a 5,200 cu. ft. gas holder and thence directly to two engines, each of which will produce 120 hp. The cooling water from these engines, augmented by the heat of the exhaust, will be circulated through the heating coils in the digester and re-circulated through the engine. A diagramatic layout of this arrangement is shown in Fig. 1.

Other plants in Great Britain will undoubtedly follow along the same lines in the development of power, especially in those instances where the price of power ranges on the high side.

In England, one of the most recent pieces of construction is at Barking, London. This old plant, consisting of sedimentation channels with barging of sludge to sea, has been in operation many years. Due to the need for increased treatment, an experimental activated sludge plant is about ready to operate, consisting of parallel installations of three Dorr clarifiers and three hopper bottom tanks, a sludge re-aeration tank with straight air diffusion, an aeration step using paddles in tanks with an upper and a lower pass, with diffused air supplied on the upper side of the lower pass. This plant will be used to determine results leading to design of new plants for London.

At Birmingham, one of the interesting features is the aeration for a short period of a portion of the sewage previous to its application to trickling filters with revolving distributors. Comparative results with filters receiving unaerated settled sewage show that the filters which are dosed with the aerated sewage operate at almost double the capacity of the others, and also do not have the usual trouble with odors and filter flies so common to trickling filters.

At Wolverhampton, just beyond Birmingham, the present plant, consisting of plain sedimentation tanks and Sheffield aeration system, is now being revamped. Several months ago two Dorr detritors were installed, and as these are of a little unusual type in regard to the manner of handling the grit directly into the cars, a photo of the end of the cleaning deck, (Fig. 2), is shown. This simplifies the operation of handling the grit very markedly. At this plant they are adding two large Dorr clarifiers, and new digestion tanks for the sludge are also under construction.

Belgium, to date, has only one biological sewage plant, that at Knocke-Zoute. These two towns are well-known summer resort towns on the coast of the North Sea and are very popular with the English, because of the splendid bathing facilities. Owning to their character, the spread between the maximum flow in the summer and

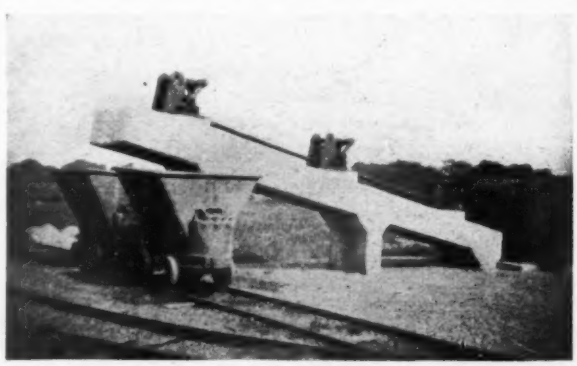

Fig. 2—Cleaning Channel of One of the Detritors at Wolverhampton, England

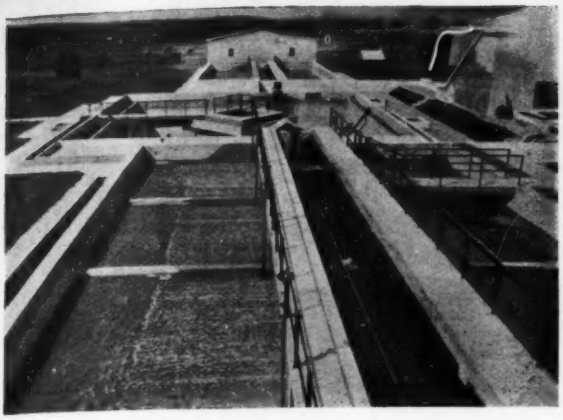

Fig. 3—Plant at Knocke-Zoute, Belgium. Activated Sludge Treatment Employing Submerged Revolving Brushes. Short Period Aeration and Long Period of Sludge Reaeration.

the minimum flow in the winter is abnormal and corresponds with the ratio found at seacoast resorts in this country. Therefore, this plant was designed to treat a large volume of summer sewage to a high degree and a small volume of winter sewage to a lesser degree. The plant was designed by Dr. H. Kessner,† and is located just over the frontier between Holland and Belgium, on the former site of one of the German fortifications in the late war. The plant has twin sedimentation tanks of the hopper bottom type, from which the sludge is pumped into a digestion tank located between them. This tank is provided with a means of sludge circulation and gas collection, although at the present time no use is made of the gas. Following the sedimentation, the sewage flows to one unit of the aeration tanks equipped with the revolving brush aerator and providing 1½ hours' retention on the summer flow. The sewage is settled in a tank of the Dortmund type and the sludge is pumped by a sludge wheel to the sludge re-aeration tank, where it undergoes 16 hours' aeration. For use in the summer, when the need for a higher degree of treatment exists, the effluent from the aeration unit is dosed on four trickling filters equipped with revolving distributors. In the winter months, with the reduced flow, the aeration step is sufficient to produce a satisfactory effluent without the use of the filters. The brushes are driven from motors located in small houses at each end of the plant. The effluent at the time of the writer's inspection, in October, 1931, and when the filters were still in use, was perfectly crystal clear and so much superior to the water supply provided at the plant that the plant operator used it as his source of drinking water. At the time of my visit he had been on duty for six months and gave every evidence of continued life and usefulness.

In Holland, considerable attention has been given to the treatment of trade wastes, and conspicuous among the operating plants may be mentioned particularly the one at Beverwijk, for treating slaughter-house wastes. This is a small activated sludge plant, designed by Dr. Kessner. It treats a normal daily flow of 7,000 gals. direct from the packing-house, which is directly adjacent. First passing through a plain Bar Screen to catch the coarser solids, the flow passes into a settling tank of the Dortmund type. The sludge is pumped by a centrifugal pump into a small tank mounted on the settling tank, which acts as a concentration tank, and from which it is drawn periodically into a closed cart and hauled away. The effluent from the settling tanks passes into a two-stage aeration tank equipped with brush aerators, of sufficient size to provide a detention of three days. Following the aeration unit is a second hopper bottom settling tank from which the clear effluent flows directly into the adjacent water course. Sludge is returned to the aeration cycle by means of a small sludge wheel. All the equipment for pump, brushes and sludge wheel is operated from the small house in the center of the plant by one motor and countershafts.

Editor's Note:—Part II of "High-Lights of Sewage Treatment in Europe" by M. Besselievre will appear in the June issue of Water Works & Sewage. In this German practice will be described.

▼

Bond Elections in April.—New state and municipal bond authorizations by the taxpayers of 24 communities reported during April totaled $9,007,000, according to *The Daily Bond Buyer* of New York. This is almost as much as the total of all authorizations for the first three months of the year and compares with $3,262,600 during March of this year.

▼

Fall Conference for Illinois Purification Plant Operators.—A fall conference for Illinois superintendents on operations for water purification plants may be held in Springfield, Ill., in October or November.

†Director, Government Institute for Waste Waters, etc., the Hague, Holland.

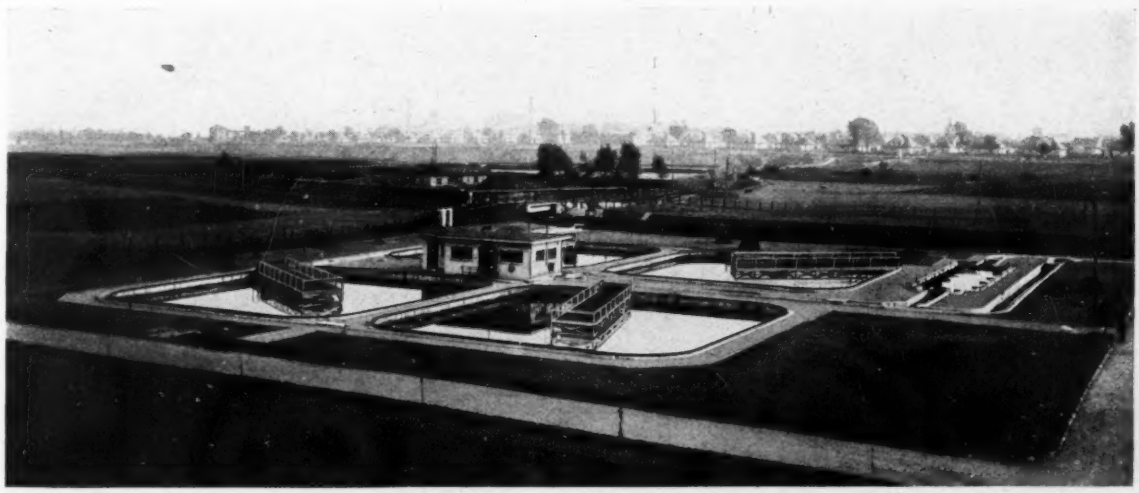

Fig. 4—Sewage Treatment Works at Klimzowiec near Katowice in Poland. Sludge Is Digested in Lagoons. There Is No Secondary Treatment.

INDUSTRIAL WATER SUPPLY ·AND TRADE WASTES·

WATER SUPPLY FOR THE PAPER INDUSTRY

By L. M. BOOTH

President, Booth Chemical Co., Elizabeth N. J.

L. M. Booth

WHEN selecting a site for a pulp or paper mill primary consideration is usually given to such factors as adequate supply of raw materials and market for the product. While the matter of water supply, especially with respect to quantity available, also receives attention, numerous plants have been located where the quality of water is not well suited to the product. There are many mills which formerly enjoyed satisfactory supplies, but changing conditions on the water shed, due to lumbering operations or pollution by upstream industries, have exerted disturbing influences on the character of the supply. Even though difficulties attributable to these sources may be merely occasional or seasonal, the effects of such water when used in paper making cause variations in the product, especially with respect to cleanliness, color sizing, etc.

In order to maintain a given standard of production the water must be uniform in quality. It is readily apparent that when there is used in the processing from 200 to 1,000 times as much water as the weight of the finished product that the quality of the water used will inevitably influence that of the product.

Fortunately, at this time, it is not necessary for the paper maker to develop his own processes for treating the water supply. His situation, with respect to this matter, is analogous to that of his associate, the power engineer. The latter, in his search for improved methods of generating power, long ago, learned the advantage of adopting the highly refined technique of the central power station industry, which has been developed primarily by the electric utility companies. In the operation of their water purification plants a number of paper manufacturers have already adopted improved treatment processes which have been developed as a result of years of research by qualified experts in the public water supply field.

Steadily rising standards of quality, coupled with the realization that uniformity of quality is imperative, are responsible for establishing a definite trend toward better operating methods in paper mill water treatment.

The objectionable substances commonly found in water from surface sources include not only suspended minerals and those of organic origin, but also dissolved solids, both mineral and organic. Coloring matter of vegetable origin is also objectionable.

Water from underground sources although usually clear and colorless, when freshly drawn, very frequently carries soluble solids which are deleterious in paper making. Dissatisfaction with the surface water at hand has led many manufacturers to put down wells in the hope that a better water supply might be developed. A study of the ratio of failures to successes in the development of wells to furnish good water in quantities sufficient for paper mill supplies discloses ample evidence that the chances of success in this kind of a venture are uncertain. Since the development of a well supply in any but proven territory is always a gamble, it is invariably good practice to consult with the most competent authorities before undertaking a well project. Frequently someone in the paper mill organization starts with a hunch, that good water will be located. This hunch is then coupled with the desire for more business, at so much per foot, by a local "practical" well driller. The result is usually later tucked away under "Deductions" in the income tax statement. Besides, after the well has been used for a while, there is no assurance that either the quantity or quality of the water, will remain the same as when the new well was tested. The cost of well maintenance, particularly where iron occurs in a water-bearing strata, is no inconsiderable item.

Formerly the paper maker adapted his technical procedure to compensate—in some measure at least—for variations in the water supply. This passive attitude made it necessary to resort to forced shut-downs all too frequently. Under 1932 conditions he is less complacent, he specifies the kind of water that he wants and takes definite steps to get it. To be sure, in some mills precise quality criteria have not yet been establishd; but most paper makers know pretty definitely what they require.

Obviously such suspended and coloring materials as occur in the raw water supply must be removed. Wherever the space conditions permit, sedimentation should be relied upon to assist in the removal of as much of the suspended matter as may be eliminated by such means. Preliminary screens, ahead of the settling basin, should be provided to exclude leaves and other trash. Where the volume of water to be treated is large enough to warrant the expenditure, mechanically operated screens such as are commonly used at modern power plant condenser water supply intakes, should be installed.

The efficiency of a sedimentation basin is dependent upon the characteristics of the material to be settled. The rate of settling may be definitely controlled by physical and chemical influences which may be brought to bear upon the settlable solids. While sulphate of aluminum alone is the coagulant most widely used to promote sedi-

mentation and to assist in filtration, the additional use of sodium aluminate in conjunction with sulphate of aluminum is sometimes advantageous. In order to handily cope with unusual water conditions special coagulants may be required.

Often, because it is cheap and is frequently carried in stock in the paper mill, soda ash is used as a water coagulation reagent in connection with sulphate of aluminum. As a general proposition the use of soda ash in this connection is unjustifiable. This the paper maker will realize when he recalls that active alkalies of this type find their greatest use in processes where dispersion, rather than coagulation, is sought. If the water to be treated is one which carries high color or is lacking in sufficient alkalinity to effectively precipitate the required amount of sulphate of aluminum, inquiry or research should be initiated with a view to finding a suitable coagulant.

For certain highly polluted waters, preliminary chlorination or chloramine treatment is effective in increasing efficiency as well as in decreasing the cost of chemical treatment. A decided advantage of the chloramine treatment resides in the fact that when the chlorine is applied in this form a desirable residual of that chemical may be maintained up to the point where the water is used for processing.

For the application of chlorine it is best to install equipment of the type which has been demonstrated to be successful in the treatment of public water supplies. Indifferent results invariably follow attempts to feed chlorine gas by makeshift means. Where there is proper understanding and control of chlorination there is no difficulty in making paper of delicate colors.

Because they have been tried and found wanting, solution feeds for coagulating chemicals are rapidly passing out of use. While the preparation and application of a solution seems simple enough, in actual practice the incidental bothers inherent to solution feeding are too numerous to be tolerated. For this reason, simple reliable feeders for dry materials have taken the place of indirect feeding methods. Since the unskilled attendant readily comprehends dry feed operation, it is easier to obtain uniform results by this means. Where a closer control is required than can ordinarily be effected by manual means, dry feeders automatically controlled by pH recording devices find ready acceptance. Naturally the most urgent need for this improved equipment is in instances where the treatment is to be applied to water which fluctuates suddenly or through a wide range. In cases of this kind frequent check tests and manual compensating adjustments, which are necessary in order to attain even a reasonable measure of uniformity, become onerous and costly. The use of automatic pH control feeders insures that the treatment will be carried out under conditions which are optimum for coagulation, regardless of variations in the quantity or quality of the water being treated.

After the coagulating chemicals have been applied, the next step is to secure adequate mixing. Suitable baffling of the mixing compartment, or in some instances mechanical agitation, affords the necessary means. The design of the settling basin has an important bearing on the over-all efficiency of the treatment plant. Due regard must be had in order to insure proper distribution of the water through the basin. The rate of flow through it should be such that a high percentage of settlable solids will be retained in the basin. Usually it is good practice to maintain less than 10 parts per million of turbidity in the water leaving the basin and entering the filters. It is poor economy to build or to use a basin which delivers an effluent carrying such an amount of solids as to require the washing of filters more frequently than once in twenty-four hours. Notwithstanding, many mill filters have to be washed three or more times daily. This involves waste of water, inconvenience, and extra cost. Sedimentation basins should be built in at least two units with provision for passing all of the water through one or more of the units at times of periodical cleaning.

The technical details incidental to the proper design of a filtration plant are legion. The filter manufacturing companies will invariably furnish as comprehensive and efficient equipment as the paper manufacturer's appropriation affords. The fact that some mills have equipment which is inadequate for the needs is usually due to a desire to limit the cost of the filtration plant to the size of a correspondingly inadequate appropriation. Lack of understanding on the part of the purchaser, of the importance of including thoroughly suitable facilities, is sometimes responsible for the installation of much of the unsatisfactory equipment now serving paper mills. Invariably better results are obtained by employing a competent consulting water works engineer to plan and supervise the work rather than by relying on the limited experience of the mill superintendent or plant engineer. Even though the best of materials and equipment are used, the plant may still be inefficient due to lack of properly coordinated design.

Paper makers spend a lot of time around the winders where their practiced eyes are able to detect the slightest variation from the accustomed standard product. If, instead, some of them would pay more attention to the supervision of the filter plant there would not be so many spots in the paper.

Some years ago, in a New England paper mill filter plant, where the alum was dissolved and applied through solution orifice box, the writer asked the attendant how much alum he was feeding. He replied that he was feeding 200 lb. for his eight hour shift, and that each of the other men were supposed to do the same. Upon calling his attention to a cessation in the feed solution, due to an accumulation of bits of burlap from the alum bags under the constant level valve seat, he cleared it out and remarked that he would increase the rate of feed so that all the alum would be used up by the time he was ready to go off—some two hours hence. As there remained, at the time considered, nearly half the total amount of solution which had been prepared for eight hours' use, it is quite evident that the method then being followed resulted in the delivery of water of varying quality throughout the run. In this instance there was no check on the filter man. He was faithful, according to his view, because he got rid of 200 lb. of alum during the time alloted.

The water from this filter plant was being used for washing stock which had been cooked with alkali. The quality of the raw water was such that more than minimum treatment with alum imparted a distinct acidity to the filtered water. Corrosion of the iron piping in this mill was naturally prevalent. The varying quality of the water, from mildly alkaline to distinctly acid was responsible for purging the mill pipe lines of annoying quantities of pipe scale which had been formed by the contact with the occasionally acid water.

In some instances a paper mill is dependent on two sources of water supply; one may be from wells and another from a river. Even though the latter may be prechlorinated, coagulated, settled, and filtered by efficient equipment, and the filter plant operation carefully checked to insure a high degree of uniformity of the filtered water, the paper maker may still have troubles which are attributable to the water supply. Although the filtered water may be just as clear as the well water,

rarely ever will it be found to be of the same alkalinity or to possess the same pH value as the well water. It is therefore apparent that indiscriminate mixing of these waters, or what is worse, varying alternate use should not be practiced. While the quality of an individual well is fairly constant, neighboring wells frequently differ widely in quality. The individual variations, as well as the quality of the resultant mixture, must be taken into consideration wherever it is necessary to mix well water and filtered water. If the mill piping or other conditions of supply or use require that a mixture of waters of varying qualities shall be used adequate provision for assuring uniformity in the quality of the mixture should be made.

Although the occurrence is rarer than formerly, one still finds filter plants where occasional coagulation is practiced. The rule followed, is to feed alum "when we think we need it." Trouble traceable to intermittent or seasonal coagulation arises because they do not think that they "need it" all the time. Invariably the practice of applying coagulant only when the water is "bad" is not justifiable. The mill supply which is treated by this plan varies too widely, especially with respect to chemical and bacteriological qualities. The filtration of uncoagulated water is responsible for the growth of objectionable deposits on the filter beds and the filtered water piping. These deposits, in part at least, are dislodged periodically, especially after the resumption of coagulation when the solvent properties of the water become more active, or at times of temperature change.

In many mills the technical organization is devoting the major portion of attention to "post mortems," i. e., tests of the finished product. Usually the variations or imperfections disclosed result from a lack of technical control in the early stages of manufacture. One of the items which often receives but cursory attention is the water supply. Since the quality of the finished product is directly dependent upon the quality of the water used, more attention should be devoted to water quality. Water which is ill adapted for use should never enter the mill.

Editor's Note:—In a subsequent article Mr. Booth will discuss the matter of water reuse in paper mills and other more pertinent facts concerning water supply for the paper industry.

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Conference of Pennsylvania Water Works Operators

The 5th annual conference of the Pennsylvania Water Works Operators' Association will be held June 20, 21 and 22 at State College, Pa.

At the pre-convention session, on the evening of June 20, John J. Shank, Director of the Wynne Laboratories at Waynesboro will lead a discussion on "Elements of Water Bacteriology."

Trouble Hour papers will be read on the following morning, Tuesday, by F. W. Buck of Scottdale, J. C. DeGroot of Northampton, J. G. Dell of Huntingdon, Martin Grogan of Sewickley, E. O. Horner of Shenandoah, R. D. Kehrer of Eagles Mere, E. B. Wagner of Downingtown, Walter Strockbine of Reading, and R. W. Woodring of Bethlehem. The business meeting will follow:

The program Tuesday afternoon includes B. F. Johnson of New Castle on "Taste and Odor Control with Activated Carbon"; Edward M. Slocum of the General Reduction Co. of Macon, Ga., on "The Action of Absorbent Clays in Water Systems", which also applies to the reduction of tastes and odors; R. F. Abel of the Menantico Sand & Gravel Co. of Millville, N J.., on "Filter Sands and Gravels", with moving pictures of the production of these materials; E. S. Hopkins of Baltimore on "The Cause, Prevention and Elimination of Mud Balls in Rapid Sand Filters"; and L. V. Carpenter of the University of West Virginia, Morgantown, W. Va., on "The Sterilizing Effect of Acid Mine Waters."

The annual dinner and round-table discussion will be held on the evening of the same day.

During the morning of Wednesday, June 22, papers will be read by A. R. O'Reilly of Reading, on "Leakage Survey at Reading"; by George H. Ashley, State Geologist, Harrisburg, on "Water Bearing Strata"; and by A. H. Behrman of the International Filter Company of Chicago, on "Water for Industrial Purposes."

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Handling Meter Complaints

By E. F. DUGGER

General Manager,
Newport News (Va.)
Water Works Commission

FOR a number of years all meters installed by the Water Works Commission of Newport News, Va., have had straight reading dials. The adoption of this dial has resulted in many patrons reading their own meters, and consequently eliminated to a great extent many complaints from the consumers from large bills. When the customer receives a larger bill for water than is customary or expected he naturally checks the meter reading, and with the straight reading dial this is more easily done, and if he finds the meter reading conforms to the reading as shown on his bill he immediately makes an examination of his own system and in the majority of cases finds his trouble. This has eliminated a great number of complaints that would otherwise be expensive to investigate and report.

The majority of complaints received from customers who have received these bills are usually accompanied with the assertion that the meter is bound to be wrong or some similar and familiar expression.

In handling complaints of this nature we agree to remove the meter, bring it to the shop and test it, but only with the understanding that the complaining party will witness the removal and test of the meter at the office. The customer usually objects to this procedure on the grounds that they are entirely too busy to spare the time to witness the test, and with the statement that they are perfectly willing to take our word for the test. This, however, is unsatisfactory to us and the patron is told that the only means by which the meter will be tested is in his presence.

The meter is brought to the office, and is tested first on 1 cu. ft., and next on 5 cu. ft. of water on a standard meter testing machine, where the patron can easily visualize the whole procedure, and fully understand the test.

This plan has materially reduced the number of complaints from our customers in reference to an erroneous measuring device, and at the same time has made many of these customers more careful and zealous of the pipe and fixtures on the premises where in 99 per cent of the cases the trouble exists.

As a rule complaints of faulty registration or mistakes in meter reading are rarely made by the same party again after having been shown to his satisfaction that the meter is not at fault.

Down on the Levee at Memphis

"Old Man River" at Memphis

THE 52ND ANNUAL CONVENTION OF THE A. W. W. A.

THE 52nd annual convention of the American Water Works Association was held May 2nd to 6th at Memphis, Tenn. It was not a large convention, but nevertheless was an excellent one, so far as the material on the program was concerned and a most enjoyable one from the standpoint of entertainment. For the first we are indebted to Chairman Fred. Cunningham, and his Publication Committee. For the latter Burt B. Hodgman and his Entertainment Committeee are responsible.

Those attending the annual dinner of the Water Purification Division heard songs and spirituals sung by an exceptional male quartet of negro voices. That quartet represented picked singers from the waiters in the Peabody Hotel dining room. Bill Orchard did himself proud as master of ceremonies, according to no less an authority than Alonzo, the head-waiter who, incidentally, has seen a toastmaster or two during his time. Paul Hansen ran well over the four minutes' speech allowed the Chairman of the W. P. Division and it is no secret that the crowd got a huge "kick" out of his witty remarks. He said that he had something to offer in competition with Bill Orchard's poems and Paul's "Swan Song," as retiring Chairman of the Purification Division, appears elsewhere in this issue. J. Wafer, a new member, was "discovered" by Bill Orchard and the result was more appreciated vocalization.

Medals and Prizes

The Diven Memorial medal, given the member "who has best served the Association," was awarded to Wm. W. Brush of New York, who for many years has served the association in several capacities and devoted much time and effort towards its betterment. Mr. Brush continues as treasurer of the association.

The John M. Goodell prize was awarded for the first time. It was voted by the committee to John R. Baylis for his exhaustive work with activated carbon.

Banquet at the 52nd Annual Convention of the American Water Works Association, Memphis, Tenn.

The exhibits by manufacturers were exceptionally good. The ballot vote by members for the most instructive exhibit showed the following order of choice: Wallace & Tiernan Co., Layne & Bowler Co., and the Dorr Co. The grand prize of $100.00 offered in the contest went to I. M. Glace of Harrisburg, Pa. Other prizes of $75.00, $50.00 and $25.00 went to J. C. Matthews, L. A. Young and C. M. Newkirk.

Gift to President Dobbin

President Ross L. Dobbin was presented with a very fine silver-and-gold cigarette case by manufacturers of water works materials in recognition of his splendid work while president of the association.

New Officers 1932-1933

The new President is **George W. Pracy,** Superintendent Water Department, San Francisco, Calif.

H. F. Blomquist, superintendent water works at Cedar Rapids, Ia., was elected Chairman of the Plant Management and Operation Division, and **C. J. Alfke,** Comptroller, Hackensack Water Co., Weehawken, N. J., is the new Chairman of the Finance and Accounting Division.

The Water Purification Division elected **J. W. Ellens** of Cleveland, O., as its new chairman and **Harry F. Jordan** continues as secretary.

Chicago will be the convention city for 1933 with headquarters at the Hotel Sherman and **Arthur E. Gorman** is Executive Secretary of the Chicago Convention Committee.

Superintendent's Round Table

"Al." F. Porzelius of Chattanooga, Tenn., proved a most proficient chairman of the Round Table and arranged for the presentation of a very interesting number of topics.

George W. Pracy recited the experiences of the San Francisco Water Department with "The Use of Non Ferrous Service Pipes in the Light of Present Prices." He said that Los Angeles used 2-in. C. I. pipe almost exclusively for servicing two houses to each take-off from the main. In San Francisco they had figured the cost of installing a ¾-in. steel service to be $12.22 and lead cost $22.00. Copper tubing installed cost $20.00 because of the necessity of cutting and replacing paving at a cost of $12.00. Copper or brass pipe could be driven under paving, requiring a 5-ft. cut at $3.75 and total installation cost of but $15.00. They had concluded that where pavement cutting was not necessary that the use of copper tubing was most practical and otherwise steel pipe would be used where driving was required. The latter used under San Francisco conditions had a long life—namely, over 25 years. Leak surveys had revealed that 70 per cent of leaks had occurred in clay soil and only 30 per cent had occurred in the light or sandy soil. In as much as 70 per cent of their services were in the light soil steel pipe could be used without trouble. The San Francisco water was non-corrosive. With 110,000 services, service repairs had cost $55,000 per year, $25,000 being chargeable to the material of the pipe.

J. E. Gibson of Charleston, S. C., said that copper tubing or pipe at present prices has the "edge" on steel. At Charleston the corrosive water and soil results in putting through of steel pipe in about 2 years. Lead pipe had been used with satisfaction, but copper was now being used. He said that they used a pipe pusher to drive steel pipe through under paving and hooked on the copper tubing which was then pulled through by reversing the pusher. (For a description of the method see WATER WORKS AND SEWAGE—November 1931.)

S. B. Morris of Pasadena, Calif., said that there considerable 2-in. C. I. pipe was used. In wide streets they had a main on each side and used copper. He said that pipe pushing had proven costly at times because of striking telephone cables.

Thos. H. Wiggin of the Federal Water Service Co. said that of 100 companies in the Federal group 75 per cent used copper tubing at present.

In reply to a question **Mr. Pracy** stated that failures of galvanized steel services had occurred at the exposed thread from exterior attack in about 80 per cent of the failures reported.

Other members reported that copper was being almost exclusively used by them now for service pipes.

"The Use of Plain End Pipe and Specials as Against Bell and Spigot Pipe and Solid Sleeves" was the topic handled by **T. J. Skinker,** engineer Water Department, St. Louis, Mo. He referred to the value of various materials used for jointing bell and spigot pipe and their limitation. Joints employing rubber rings had proven valuable in pipe up to 16-in. diameter and were superior to metal for gas lines. XX simplex joints and Dresser couplings had proven very satisfactory above 25 lb. and up to at least 150 lb. pressure.

H. P. Boncher of the Dresser Mfg. Co. said that Dresser gaskets were of compounded material rather than pure rubber and explained the reasons for longevity of the material in service since 1910. He said that cadmium plated bolts were used to prevent corrosion of that important element.

Col. T. A. Leisen of Omaha, Neb., reported that he had found Simplex joints to cost about $1.44 less length of pipe than did Dresser joints used on 6-in. lines. For 8-in. lines the difference was $1.79 per joint.

Mr. Hibbs, Superintendent Water Works, Cincinnati, O., remarked on the great convenience of the Dresser coupling in connection with cutting water mains for cleaning.

A. F. Porzyeleus reported on the very satisfactory performance of Dresser couplings in standing bridge vibration on an exposed line now in service for more than 6 years.

"Sterilization of New Mains and Mains Contaminated During Repair Work" was introduced under the leadership of **W. W. Brush,** Chief Engineer Department of Water, Gas & Electricity, New York City. In laying new mains the New York practice had been to add a tablespoon of chlorinated lime in each length of pipe. The section of lime would then be filled with water, allowed to stand over night, flushed and samples tested for contamination. If necessary liquid chlorine would then be applied from a portable outfit. A water pressure 5 to 6 times that on the main would be required to operate the chlorinator. That could be effected by taking water from one side and delivery of chlorine water to low pressure side of a throttled valve. The water would be wasted at the far end of the new main until the residual chlorine test showed between 1 and 5 parts per million of chlorine. After standing 4 hours the line is flushed and water samples taken for examination. The treatment is repeated if tests are not satisfactory. To sterilize joints a saturated chlorinated

Ross L. Dobbin, retiring president, A. W. W. A.

George W. Pracy, incoming president, A. W. W. A.

lime of H. T. H. solution is applied to each joint inside. To operate the chlorination most efficiently an auxiliary pump to build up injection water pressure was quite an advantage. Each cylinder of chlorine connected would feed out at the rate of not more than 20 to 30 lb. per hour in summer and much less in winter unless heat was supplied.

Mr. Brush said that it would be essential to clean the main as effectively as practicable before sterilizing, if good results were to be expected.

Robert Spurr Weston of Boston described the sterilization of 20.5 miles of a double 74-in. conduit on the Wanaque supply of Jersey City, N. J. He had by experience preferred to use liquid chlorine and chlorinators of the W. & T. make had been used. At the rate of 10 m.g.d. flow the line had been filled with water containing initially 8 p.p.m. available chlorine; after 4 hours flow down the conduit that had dropped to 4 p.p.m and 20.5 miles away at the far end of the conduits 2 p.p.m. remained. After 24 hours standing the lines were drained and refilled. Tests indicated no b. coli and only 5 bacteria per c.c. in samples taken.

Mr. Griswold of the Hartford (Conn.) Metropolitan Water Commission said that the procedure at Hartford had been to use the high test hyperchlorite produced by Mathieson Alkali Works, adding 5 lb. per 100 ft. run of 6 to 16-in. line. That would figure for 3 parts per million of chlorine in the 16-in. to 18 parts in the 6-in. lines when filled. The employment of the excessive application in the 6-in was practiced in order to have uniformity of procedure for all sizes and that was an advantage. Where a new line must stand for some time before cutting into service liquid chlorine is used when ready for placing in service and applied sufficient to produce a residual of 6 p.p.m. chlorine at the end bleeder valve or hydrant. Low chlorine pressures had been a difficulty met with in winter.

"Need of Cooperation Between Architects, Plumbers and Water Departments" proved a live topic for discussion led by **J. E. Gibson** of Charleston, S. C. He pointed out the lack of proper appreciation of the limitations of small pipe sizes, and the necessity of providing materials less corrosive than steel piping in many instances, which prevailed in the architectural and plumbing fields. **Mr. Gibson** said that much of value could be learned by builders if they would consult the Water Department before specifying size and quality of piping to go into residences, apartments or office buildings.

At St. Paul, according to **Mr. Thompson,** it had become a rule that nothing smaller than ¾-in. service pipe run across the basement would be acceptable.

T. H. Wiggin remarked that cold water piping was not the important element. Corrosion in the hot water system was of primary importance and created a real difficulty.

H. O. Sweet of Birmingham in defending the plumbers held the architects more responsible.

"Emergency Protection of Water Works in Flooded Areas" was the subject of a finished paper by **F. E. Hall,** Superintendent of Water Works, Greenville, Miss. Mr. Hall gave a resume of their experiences at Greenville during floods and the emergency operation procedures evolved. Mr. Hall warned that a Superintendent need only have one such experience to have impressed on him the value of being prepared in advance to cope with emergencies.

"Paint Markings for Fire Plugs" was the subject dealt with by **J. W. McAmis,** Superintendent of Water and Sewerage at Shreveport, La. He pointed out the advantages which should result from the adoption of a distinctive painting of fire hydrants that would indicate immediately the volume of stream flow procurable, the size of water main and pressures available. Mr. McAmis having served once with a fire department felt that such markings would prove of value to the fire fighters and thus prevent mistakes, such as pumping at rates in excess of the main delivery to the pumper or the use of a greater number of hose lines than there would be adequate to properly supply residual pressure. Mr. McAmis suggested a color scheme and painted numerals to indicate the available flows from each hydrant.

In discussion from the floor it was reported that the Maine Water Utilities Association had taken definite steps in that same direction and it was suggested that a single scheme of colors and markings should be evolved for use in all cities to make for uniform standardized practice. That would have a distinct value when one fire department might be called to a neighboring city to offer assistance during a conflagration. It seems that the hydrant markings adopted by the Maine Water Utilities Association are as follows:

Class A—To supply 1 or more pumpers at 1,000 gals. min. Tops and nozzles, green.

Class B—To supply not less than 500 gal. min. Tops and nozzles, yellow.

Class C.—Less than 500 gal. min. Tops and nozzles, red.

Mr. Mowry of the National Board of Fire Underwriters thought that the size of main should be shown on the hydrant. He considered this move in the same general direction as had been the standardization of hose threads.

"Organization of Water Departments for Emergencies" was covered by **J. S. Dunwoody,** Superin-

A. F. Porzelius, retiring chairman, Maintenance Division

H. F. Bloomquist, incoming Chairman, Maintenance Division

tendent Water Department at Erie, Pa. He said that one foreman was kept on duty at night and five men were subject to call. He felt that the time was approaching when Erie should have a standing emergency crew of 3 men for night service. With the present scheme they had one foreman quartered in an apartment next to the repair shop which meant that he was immediately available when needed. The Erie repair and emergency truck was equipped with an electric and air operated valve closing mechanism, but on the whole the air operated equipment was preferable in valve operation. Every large valve on the system had permanent electric leads to the location.

Considering pressure water supply for valve operation at filter plants and pumping stations, Mr. Dunwoody said that at least two separate sources of pressure water should be available. For boiler water input the feed pumps should be supplemented by an injection and auxiliary source of water supply.

Wm. C. Mabee, Chief Engineer of the Indianapolis Water Co., said that his company has 1 man on continuous night duty as contrasted to the rotation of men as practiced at Erie. A night crew of five men was subject to call by phone for night duty in valve operation, etc., and repairs were then made by the day force. They at Indianapolis had very definite plans perfected in advance as to what action to follow in case of emergencies, such as conflagration, tornadoes, flood, etc. The men had to know what was expected of them immediately should such catastrophies occur.

A. E. Gorman executive secretary, Chicago Convention Committee

W. W. Brush, Diven Medalist, 1932

T. J. Spinker of St. Louis referred to the equipment for illumination during night work. The 3-ton Dodge truck had been equipped with an 800 watt Kohler generator set and the better lighting had increased night-work efficiency to at least 100 per cent.

A. F. Porzelino said that at Chattanooga they kept one man on continuously for emergency night duty.

"How Frequent Should Meters Be Tested?" was the question handled by **H. F. Blomquist,** Superintendent Water Works at Cedar Rapids, Ia. Mr. Blomquist presented a particularly valuable report covering observations in practice and a long period meter test made at Grand Rapids. His paper will be printed in a subsequent issue of WATER WORKS AND SEWERAGE. Mr. Blomquist said that the frequency of needed testing would be governed by the quality of water supply. Deposits in the meter (organic or mineral) would result in over-registration and any suspended matter to create wear of moving parts would create under-registration. For the Cedar Rapids conditions the data available led him to believe that small meters would remain accurate during 10 years of service if not longer. He thought that meters of 2-in. or larger size should be tested every two years because of the relative importance of maintaining accuracy of the larger sizes. They had found a tendency of 1 to 2 per cent over-registration by ⅝-in. meters during first three years of service. They specified 98 per cent accuracy for new meters on that account and when repaired they were reset for 97 to 99 per cent accuracy. He felt that there was a new and real need for more sensitive meters because of the small flows passing through gas-operated refrigerators, air conditioning equipment and to record small leakage. Mr. Blomquist also offered several valuable suggestions for facilitating repair work and remarked that the softened filtered Cedar Rapids water probably was less harmful to meter parts than other types of waters which might be of a depositing or corroding nature. In other words: quality of water had a significant bearing on the life and accuracy of water meters.

At Cedar Rapids they were using six different makes of meters and found them all very much on a par and they had kept very accurate records on cost of meter repairs.

A. F. Porzelius said that in as much as quality of water affected the accuracy of meters they at Chattanooga had a rule to make meter tests based on meter registrations rather than period of service. That plan applied more particularly to the larger meters than the small ones and also it was their plan to bring the meters to the shop for testing because of the ecenomy of that procedure as against the field test.

Mr. Hawley of Wilkinsburg, Pa., commented on the failure of the average worn meter to register rates of 200 to 300 gal. flow per day.

Mr. Porzelius suggested that it might be of value to water works managers to secure a list of owners of gas refrigeration for the local gas company if that could be gotten. He had done as much himself and the information was of value.

W. S. Patton, Manager Water Works at Ashland, Ky., in commenting on non-registration of low flows, suggested that members might do well to look into the "Gulper," a new device displayed by the Ford Meter Box Co., which had been developed by Mr. Earl of New Orleans. This instrument fits onto an ordinary meter and causes it to register every particle of flow passing through. It was so new that nobody had had a chance to learn much about it as yet, but it looked very interesting.

Mr. Truman, Superintendent Water Works, Colorado Springs, Colo., said that frequently the increased water bills had been greater than they had anticipated following refrigeration installations in residences. He thought this was due to the fact that the increased small flow added to the existing leakage (not registering) had made a total which was registered and thus the refrigeration had been blamed when really the leaks were responsible. The refrigerators had perhaps been a means of getting pay by water companies for wasted water heretofore not registered.

Mr. McDowell of Charleston, S. C., said that their practice was to inspect and test meters of 2-in. size and over every 3 months. All meters in service more than 7 years were being tested at the rate of 300 per

month. Meters installed in 1912 had shown the greatest error to be 3 per cent.

"Making Water Works Properties Attractive" was the topic handled by **O. Z. Tyler,** Superintendent Water Department, Jacksonville, Fla. Mr. Tyler's contribution was replete with suggestions as to the proper procedure in beautification of water works properties. He said that the grounds should be attractive in order to increase the public's good opinion of the department and its activities, and that moderate beautification was preferred to an over elaborate scheme. He called attention to the improvement of interior of buildings as well as the surrounding grounds. For sloping banks and shady spots he had found Sunaper grass (a cross between Bermuda and St. Augustine grass) to be the best. He felt that hardy evergreens should be used to a large extent and supplemented by a formal style of garden treatment with winding paths. Driveways into the property were not particularly desirable.

A. P. Michaels, Manager Orlando Utilities Commission, Orlando, Fla., reported that beautification was not alone a good will builder, but had resulted in increased water consumption. Beautification could readily be extended to the entire community through Garden Club work and thus increase water workers' income by greater use of water for sprinkling.

The Chairman reported results of a remunerative nature had been secured by the West Palm Beach Water Co. when Mr. Reynolds had put on an expert landscape architect who advised Garden Clubs and others concerning industrial property beautification. Water sold as a result had been considerably more than sufficient to support that work.

At St. Paul, Minn., considerable had been accomplished in good will building by developing a park around the water works buildings. The lake had been beautified by plantings around the shore line.

A. U. Sanderson of Toronto pointed out the tendency to improve the appearance of water works buildings and that was a most commendable move to go hand in hand with grounds beautification.

Mr. Sims, Superintendent of Water Works at Spartanburg, S. C., was asked by the chair to report on what they had done at Spartanburg. He told of the good will developed when the Water Department constructed an artificial lake for recreational purposes. Filtered water goes to that lake in varying amounts and the surrounding grounds are maintained by the department as well as the purity of the water for bathing.

Mr. Burkenbine of Philadelphia reported the impressions made on the layman visiting various water works and how much higher the opinion of the visitors had been of the plants that had been beautified than had been the case with others producing perhaps even a more satisfactory product but lacking in attractiveness.

If comments are in order this writer might add that usually the best product comes from the most neatly kept plants which usually have attractively maintained surroundings.

This topic created considerable interest and prolonged discussion which is indicative of a happy trend in the water works field.

"Government Documents Useful to Water Superintendents and Where They May Be Obtained" was the subject handled by **A. F. Porzelius,** Superintendent City Water Co. of Chattanooga, Tenn. The author listed the available Governmental publications of value to water works superintendents and since the contents of the paper are valuable for filing for reference to Mr. Porzelius' paper will be printed in a subsequent issue of WATER WORKS AND SEWERAGE.

"Experience with Cement Lined Cast Iron Pipe" was recounted by **E. O. Sweet,** Superintendent Birmingham Water Works Co., Birmingham, Ala.

Mr. Griswold of Hartford, Conn., had experienced objectionable leaching of lime salts from cement limings which necessitated bleeding of the lime for 6 to 8 months. He had since specified bituminous coating of the cement lining.

Mr. Moore of the Research Department of the American Cast Iron Pipe Co. described methods of coating application to cement lined pipe, but had also developed a leaner formula for the concrete used in lining pipes and had thus eliminated objectionable features of the richer cement lining. The reasons for "checking" or loose lining were discussed and he reported no experience with lining above 24-in. diameters, but the latter had proven satisfactory with the leaner cement.

E. E. Bankson Consulting Engineer of Pittsburgh, Pa., reported difficulty with loose lining in 36-in. diameter pipe.

"Inventory Methods for Yard Stocks" was discussed, **C. J. Alfke** of the Hackensack Water Co., Weehawken, N. J., serving as the leader. Mr. Alfke outlined the essential steps in the control of materials, including the "tag method" of making an inventory and the procedure adopted by the Hackensack Water Co. He recommended that inventories be made by company employees that are not connected with the store keeping department and that physical inventories and book inventories should be checked always. In reply to a question as to handling of record of missing equipment he said that a very thorough search was always made before charging it to loss.

J. S. Dunwoody, Superintendent Water Department at Erie, Pa., reported that at Erie they made it a practice to charge issued materials and equipment to the individual foreman drawing such and that the foreman must account for same.

A. P. Michaels of Orlando, Fla., reported on the stock-card system employed in recording bin stock on hand and removed.

W. S. Patton, Manager Ashland Water Works, at Ashland, Ky., led the discussion of the topic, **"Devices to Aid in Locating Underground Structures and Leaks."** After referring to the devices on the market for leak location—such as the microphone—he reported on another scheme employing the drilling of small holes in the paving in order to trace the source of the water.

Patrick M. Geer, Superintendent Water Works at Holyoke, Mass., described an ingenious method of locating a baffling leak. The equipment employed consisted of no less than a tincan and a length of wire.

PAPERS AND DISCUSSION

A report covering papers presented before the Water Purification Division appears elsewhere in this issue. A digest of papers presented before the Main Sessions and the Finance and Accounting Division will appear in the June issue of WATER WORKS AND SEWERAGE.

THE LIME-CHLORINE PROCESS OF SEWAGE TREATMENT AT BALTIMORE

By C. E. KEEFER and G. K. ARMELING

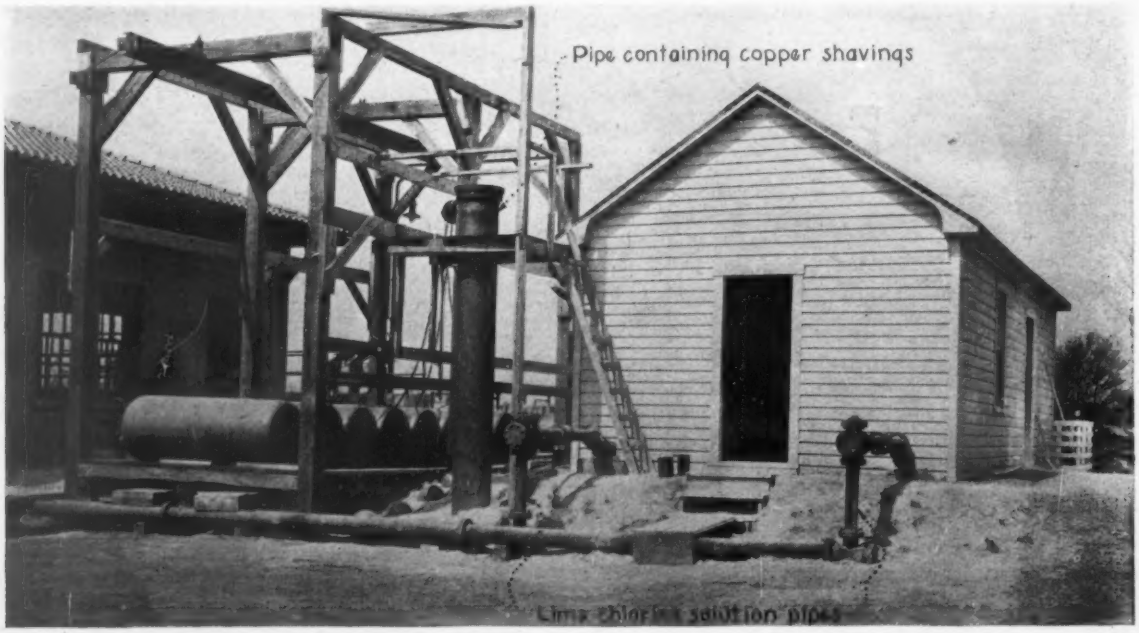
Principal Assistant Engineer, Sewage Works
Superintendent, Bureau of Sewers, Baltimore, Md.

DURING the past few years there have been considerable algae growths in Back River, the tidal estuary, into which the treated effluent from the Baltimore sewage works discharges. These growths have been attributed by the property owners along the river to the presence of the nitrified effluent from the sewage plant. As there are a large number of valuable shore front properties on both sides of the river, which is extensively used for boating, bathing and fishing, it was considered desirable to do everything possible to control the algae growths. It was, therefore, decided in the fall of 1930 to see what effect chlorine would have. First, a series of laboratory experiments, consisting of treating the sewage effluent with (1) chlorine and (2) chlorine and lime, were made to learn which was cheaper and more efficacious. The latter treatment was found to be the better of the two. The chemicals were introduced into the river by adding them direct to the final sewage effluent before its discharge into Back River. The treatment was begun in March, 1931, and continued throughout the summer of that year. The results were sufficiently promising to warrant the continuation of the work during the summer months of 1932.

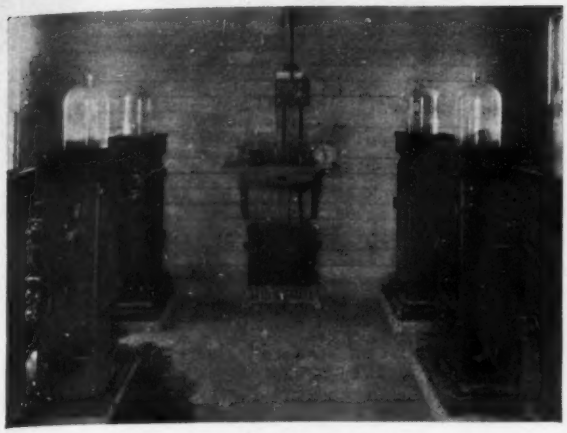
The sewage works is a sedimentation-trickling filter plant with a flow (1931) of 60.97 M. G. D. The settled sewage is treated on 30 acres of trickling filters, and again settled in two humus tanks. The effluent, then, flows through conduits 4,100 ft. long, and discharges into Back River. This stream, which is a tributary of the Chesapeake Bay, has a drainage area of about 45 sq. mi. above the sewage works. As the run-off is small, the tide, which average about 1.5 ft., plays the major part in diluting the effluent. Below the sewage works the stream extends for about 9 miles to the bay, and has a width of approximately ¾-mile and an average depth of about 4 or 5 ft. Above the sewage works the stream is navigable in small boats for about 1¾ miles. Generally speaking the bottom of the river is sandy in character and free from the larger rooted aquatic vegetation. The algae, which predominate during the summer months, are clathrocystis and coelosphaerium. These organisms start to diminish in October, at which time diatoms begin to increase. On numerous occasions large numbers of crustaceans have been noted. When these zoöplankton increase in numbers, the algae decrease. The aquatic vertebrates consist mostly of white and yellow perch, carp, catfish and menhaden, of which there are large numbers.

Preliminary Tests.—The treatment of sewage with liquid chlorine and hypochlorite of lime has been practiced for many years, and more recently chlorine has been used to control algae growths, especially in waters used for human consumption. The writers, however, know of no instance where the "lime-chlorine" process has been used to treat either water or sewage prior to the preliminary tests and full scale operation in Baltimore. With the knowledge that calcium hypochlorite could be made from chlorine and lime, laboratory tests were conducted, consisting of treating portions of the sewage effluent with (1) chlorine water and (2) chlorine water and lime mixed in the proper proportions. As shown in Table I, these tests indicated that an average of 3.70 p.p.m. of chlorine was needed to satisfy the initial demand while only 1.18 p.p.m. of chlorine in the form of hypochlorite solution were required.

Additional tests were made in order to produce 0.5



Chlorine House and Chlorine Containers, Back River Sewage Works, Baltimore, Md.



Chlorinators Feeding Into Lime Line, Baltimore Sewage Works

p.p.m. of residual chlorine in the effluent. When chlorine water was used, 6.19 p.p.m. were needed, while with hypochlorite solution only 3.69 p.p.m. were required, a saving of 40.4 per cent. Furthermore, when starting with a residual of 0.5 p.p.m. of chlorine in the effluent, chlorine could be detected for an average of 6.7 hr. when chlorine water was used and for 11.3 hr. when the combination of chlorine and lime was applied.

If it is assumed that 3.69 p.p.m. of chlorine as calcium hypochlorite will produce the same amount of residual chlorine as 6.19 p.p.m. of chlorine dissolved in water, the former process of treatment is much cheaper. A calcium hypochlorite solution produced by 596 lb. of chlorine and 745 lb. of hydrated lime would give the same residual as 1,000 lb. of chlorine and at the same time would be more effective. With chlorine at 2 ct. and hydrated lime at ½ ct. a pound each 1,000 lb. of chlorine used would cost $20 whereas the treatment with chlorine and lime would cost $15.65, a saving of 21 per cent. During the spring and summer of 1931 a total of 194 tons of chlorine and 252½ tons of hydrated lime was used. The cost of these materials, exclusive of all labor and hauling charges was:

Chlorine, 194 tons at $42.39	$ 8,223.60
Hydrated lime, 252½ tons at $9.25	2,335.63
Total	$10,559.23

If chlorine alone had been used, it is estimated that 325½ tons would have been needed, and would have cost about $13,800.

The equipment, used in applying the chemicals, consisted of six Wallace & Tiernan chlorinators, four of which have a capacity of 750 lb. and the other two a capacity of 350 lb. of chlorine daily, and two dry-feed lime machines. As it was not known whether the installation would be a permanent one, the equipment was housed in a wood frame building. The lime-feed machines were placed in a separate room from the chlorinators so that there would be no lime dust around the chlorinating equipment. The apparatus was installed in two independent batteries, each consisting of two 750-lb. and one 350-lb. chlorinators and one lime-feed machine.

Each lime-feed machine operates automatically, and feeds the proper quantity of lime mixed with water through a 4-in. cast iron pipe to the sewage effluent channel. Chlorine dissolved in water also flows into this pipe line. The ratio of chlorine to hydrated lime necessary to form alkaline calcium hypochlorite is approximately 1 to 1.25. In order to be sure that there is an excess of lime, "flash" tests* with a solution of phenolphthalein are made.

The chlorine is delivered to the sewage works by trucks in 1-ton containers, which are placed on a raised wooden platform adjacent to the chlorinating house. A wooden framework with a chain hoist is provided over the platform for moving the cylinders.

Chlorine and lime were first used on March 23, 1931. From then until May 15 approximately 3,000 lb. were used daily. As there was a considerable variation both in volume and the strength of the sewage during the day, it was decided to vary, to a certain extent, the quantity of chlorine and lime used with the sewage flow. From May 15 to July 3, 1931, therefore, 1,850 lbs. of chlorine were used daily from 4 p. m. to 4 a. m. and 1,100 lbs. during the remainder of the day. As the temperature and the atmospheric conditions for the growth of algae were ideal during July and August, the chlorinators were operated at their maximum capacity of 3,700 lbs. a day until Aug. 29, 1931, when the treatment was discontinued for the rest of the year.

Little difficulty was experienced with the operation of the equipment. At times the pipes became clogged with deposit, and had to be cleaned. The pipes, through which the chlorine water flowed, were connected to the cast iron pipe line containing the lime water by means of malleable iron fittings. These corroded through, and have since been replaced with cast iron fittings.

Bacterial counts, made of the river water at the point where the effluent discharges, gave the following results:

Date	Total Bacteria per cc.	B. Coli Bacteria per cc.
May 20, 1931	10,000	0
June 17, 1931	5,000	0
Aug. 27, 1931	400	0
April 26, 1932	2,000	0

Copper Chloride Treatment.—In addition to using chlorine and lime it was decided also to experiment with copper chloride. A 12-ft. length of 16-in. cast iron pipe was, therefore, set in an upright position and filled with fine copper turnings. The bottom of the pipe was set in concrete, and made water-tight. Chlorine water flowed into this pipe at the bottom, and the copper chloride solution discharged at the top.

Copper chloride was used from July 16 to Aug. 17, 1931. Approximately 0.1 p.p.m. of copper as copper chloride was applied per million gallons of sewage treated. A series of laboratory experiments were conducted to determine what effect, if any, small quantities of copper would have upon the algae. When using 0.5 p.p.m. of cupric chloride, there was no indication that this chemical inhibited algae growth.

B. O. D. Reduction.—Numerous investigators including Mohlman, Baity, Rudolfs and others have reported on the B. O. D. reduction of sewage treated with chlorine. It was considered of interest to collect samples both of the untreated and the chlorinated effluent, and determine the reduction in B. O. D. Some of these samples were incubated for 5 and others for 20 days. All tests were made by the direct oxygen (Sierp) method. As indicated in Table II the average 5-day B. O. D. of the untreated effluent was 48 p.p.m. and that of the treated effluent was 32 p.p.m., a reduction of 33 per cent.† The 20-day B. O. D. of the unchlorinated effluent averaged 116 p.p.m. and the corresponding chlorinated effluent had a B. O. D. of 10 p.p.m., a reduction of 14 per cent.†

*A pink "flash" is produced when phenolphthalein solution is dropped into a sample of the chlorinated lime solution. The bleaching effect quickly destroys the pink coloration.

†Note that the actual reduction was the same (16 p.p.m.) in each case.

TABLE I—FINAL EFFLUENT TREATED WITH CHLORINE AND A MIXTURE OF CHLORINE AND LIME

Sample No.	Cl_2 Required to Satisfy Initial Cl_2 Demand: Cl_2 Water p.p.m.	Cl_2 Required to Satisfy Initial Cl_2 Demand: Cl_2 and Lime p.p.m.	Cl_2 Required to Give 0.5 p.p.m. Residual Cl_2: Cl_2 Water p.p.m.	Cl_2 Required to Give 0.5 p.p.m. Residual Cl_2: Cl_2 and Lime p.p.m.	Time Cl_2 Remained when Treated to Give Originally 0.5 p.p.m. of Cl_2: Cl_2 Water hr.	Time Cl_2 Remained when Treated to Give Originally 0.5 p.p.m. of Cl_2: Cl_2 and Lime hr.
1.....	3.45	1.32	8.51	4.49	6.00	11.00
2.....	2.76	1.25	5.72	3.75	6.8	11.00
3.....	2.80	1.20	5.60	3.59	5.8	11.8
4.....	2.08	0.94	4.91	2.93	8.2	11.3
Average	3.70	1.18	6.19	3.69	6.7	11.3

TABLE II—B. O. D. REDUCTION OF SEWAGE EFFLUENT TREATED WITH CHLORINE AND LIME

Test No.	Incubation Temperature °C	Residual Cl_2 p.p.m.	B.O.D. 5 Days: Chlorinated p.p.m.	B.O.D. 5 Days: Unchlorinated p.p.m.	B.O.D. 20 Days: Chlorinated p.p.m.	B.O.D. 20 Days: Unchlorinated p.p.m.
1....	20	1.0+	23	40	..	..
2....	20	0.7	17	58	..	..
3....	20	0.5	25	44	..	..
4....	20	0.5	48	54	87	98
5....	20	0.4	59	58	102	120
6....	30.7	0.5	31	40	120	124
7....	30.7	0.5	29	38	112	114
8....	31.7	0.6	26	54	77	122
Av'ge	..	..	32*	48	100*	116

*Note that the 16 p.p.m. reduction holds during the 20-day period.

During 1931 there was a marked reduction in the number of algae in the river as compared with 1930. As there were a number of other environmental factors affecting the algae growth in the river such as turbidity, number of sunshine hours, rainfall, etc., it is difficult to determine the part which the lime-chlorine treatment played in the reduction of algae. There is reason, however, for believing that the lime-chlorine treatment was beneficial; so the work is being continued during 1932. The use of lime and chlorine as adopted in Baltimore furnishes the engineer with an additional means of treating sewage. This method of treatment offers possibilities which should recommend it for extensive use in the field of sanitary engineering.

The sewage works is under the general supervision of B. L. Crozier, Chief Engineer of the Department of Public Works, and George E. Finck, Sewerage Engineer. Acknowledgments are due to Linn H. Enslow of the Chlorine Institute, who suggested that the lime-chlorine treatment be tried, and Edward Cromwell and Henry Weiner, Principal Sanitary Chemist and Junior Chemist, respectively, of the Baltimore sewage works.

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Southern Illinois Conference on Water Purification

A conference on water purification, primarily for superintendents and operators, will be held May 27 at the Chemistry Building, State Normal University, Carbondale, Ill. The conference will be under the auspices of the Division of Sanitary Engineers, State Department of Public Health, and the Illinois Section of the American Water Works Association. The program follows:

9:00-9:30 a. m. Opening of conference. Harry F. Ferguson, Chief Engineer, State Department of Public Health; John R. Baylis, Chairman, Illinois Section, American Water Works Association.

9:30-10:45 a. m. "Coagulation, Mixing and Settling." Discussion opened by John R. Baylis, Physical Chemist, Department of Water Supply, Chicago.

10:45-12 Noon. "Aeration, Tastes and Odors." Discussion opened by M. S. Sabin, Sanitary Engineer, State Department of Public Health.

12-1:30 P. M. Luncheon.

1:30-2:45 P. M. "Chlorination." Discussion opened by A. E. Gorman, Filtration Engineer, Chicago.

2:45-3:00 P. M. "Softening and Iron Removal." Discussion opened by Chas. Spaulding, Chemist, Springfield.

3:00-4:00 P. M. Miscellaneous Topics and Question Box. Discussion opened by C. S. Gill, Superintendent of Waterworks, Carbondale.

4:00-6:00 P. M. Inspection of Carbondale Reservoir and Water Purification Plant.

6:00-7:30 P. M. Dinner.

7:30-8:30 P. M. "Water Supplies Around the World." Illustrated talk by H. E. Babbitt, Professor of Sanitary Engineering, University of Illinois.

If it is desired to exhibit material, in addition to having a representative present, communication should be made directly with C. S. Gill, Superintendent of Waterworks, Carbondale, who is taking care of local arrangements.

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Pennsylvania Sewerage Works Conference Meets in June

The 1932 Conference of the Pennsylvania Sewage Works Association will be held June 22, 23, and 24 at State College, Pa. The program follows:

WEDNESDAY, JUNE 22, 1932

7:30 P. M. "Moving Pictures of Sewage Treatment Works." E. Sherman Chase, Metcalf & Eddy, Boston, Mass.

THURSDAY, JUNE 23, 1932

Morning Session

8:30 A. M. Registration.

9:30 A. M. Address of Welcome.

9:45 A. M. "Activated Sludge Practice," Philip B. Streander, Consulting Engineer, Philadelphia, Pa. Discussion, Wellington Donaldson, Fuller & McClintock, New York City, N. Y.

10:30 A. M. "Sludge Digestion Experiences at Baltimore." Edward Cromwell, Principal Sanitary Chemist, Bureau of Sewers, Baltimore, Md.

11:15 A. M. Business session.

12:00 Noon. Recess.

Afternoon Session

1:15 P. M. "Explosion Hazards of Gas from Sewage Sludge Digestion Tanks," George W. Jones, Chemist, U. S. Bureau of Mines, Pittsburgh, Pa. Discussion, John R. Downes, Supervising Engineer, Plainfield-Dunnellen Sewage Treatment Plant, Plainfield, N. J.

2:00 P. M. "Design and Preliminary Results of Operation, Erie Sewage Plant," A. B. Cameron, Superintendent, Erie, Pa. Discussion, John T. Campbell, The N. J. Chester Engineers, Pittsburgh, Pa.

2:45 P. M. "What the Pennsylvania Department of Health Expects of Each Operator," L. S. Morgan, District Engineer, Pittsburgh, Pa.

3:30 P. M. "Function of Each Unit of a Sewage Plant," Isaac S. Walker, Consulting Engineer, Philadelphia, Pa.

4:15 P. M. Recess.

7:00 P. M. Dinner and Round Table Discussion, H. E. Moses, leader, Assistant Chief Engineer, Department of Health, Harrisburg, Pa.

FRIDAY, JUNE 24, 1932

Morning Session

SEWAGE PLANT OPERATORS' SYMPOSIUM

9:00 A. M. "How to Start a New Sewage Plant," Harry M. Beaumont, City Hall Annex, Philadelphia, Pa.

9:30 A. M. "Insect Control," W. J. Simpson, Reading, Pa.

10:00 A. M. "Winter Operation," R. R. Cleland, Engineer, Sewage Disposal Plant, State College, Pa.

10:30 A. M. "Control of Odors," W. A. Ryan, Rochester, N. Y.

11:00 A. M. "What Constitutes an Acceptable Effluent," William C. Emigh, City Engineer, Coatesville, Pa.

11:30 A. M. "Laboratory Control," M. J. Blew, Assistant Engineer, Northeast Sewage Treatment Plan, Philadelphia, Pa.

12:00 M. Adjournment.

FILTRATION PLANTS

A Section Dealing with Their Design, Construction and Operation

Conducted by JOHN R. BAYLIS, Associate Editor
Physical Chemist, Bureau of Engineering, Chicago, Ill.

WATER TREATMENT AND PURIFICATION PROBLEMS DISCUSSED AT THE MEMPHIS CONVENTION OF THE A. W. W. A.

THE attendance of water purification engineers and chemists at the Memphis, Tenn., Convention was not quite up to that of the past few years, but considering the times and the fact that Memphis is some distance from the center of gravity of the membership it is surprising that the attendance was as large as it was. This probably was due, in a large measure, to the interesting and diversified program arranged by Chairman Hansen. All water purification sessions were well attended and the papers were discussed to the extent that the sessions usually finished behind time.

The Water Purification Dinner.—The annual dinner of the Water Purification Division has now become one of the notable events of the convention. In order to divert our minds from serious thought at least for the duration of the dinner it was decided a few years ago to have some form of entertainment. Wm. J. Orchard, one of our members, was called upon to be master of ceremonies, and he proved so highly entertaining that he has been called upon from year to year to handle this part of the program. Each year the inimitable "Bill" arranges a program more interesting than the one of the previous year. The dinner on Tuesday evening was the best and most enjoyable one which has been held. Our "Bill" was at his best, and he was ably assisted by local colored talent and by Chairman Hansen.

Colon-Aerogenes Types of Bacteria as Criteria of Fecal Pollution: F. O. Tonney and **R. E. Noble.**—Early efforts to detect pollution in water were largely by chemical tests, but these tests were later largely replaced by the B. coli test which is regarded as being more indicative of dangerous pollution. The preset test for B. coli using lactose broth determines organisms of both the coli and the aerogenes group. Not many aerogenes come from the intestines of human beings and significance should be attached almost entirely to coli of fecal origin. The advantage of direct plating on the Noble cyanide-citrate media for enumerating the coli and for distinguishing between fecal coli and members of the aerogenes group was stressed. The ratio of B. coli to aerogenes in feces is about 100 to 1, and in soils and decaying vegetation the ratio is about one B. coli to 20 aerogenes. In sewage the ratio of B. coli to aerogenes is about 1 to 1.4. The resistance of the two groups is about the same; that is, they die upon standing at about the same rate. Frank E. Hale, in discussing the paper, stated that about 99 per cent of B. Typhosis in water die within two weeks. He did not believe there was any advantage in separating the coli and aerogenes groups. T. R. Lathrop said that the cyanide-citrate method of enumerating and differentiating the B. coli from aerogenes was simple, and that it gave a reasonably accurate indication of the B. coli and the aerogenes.

Conformity of Public Water Supplies to U. S. Treasury Standards: Ralph E. Tarbett.—The author explained the U. S. Treasury Department Standards for drinking water on common carriers. Testing the water supplies is left largely to the State Departments of Health in the various states. The statistics given were only on supplies where the water is used on common carriers. There are about 1,950 such supplies, and out of 1,836 supplies in which there are reports as to quality, 79 per cent pass the U. S. Treasury Department standards and are approved. There are 18.5 per cent of the supplies which have received provisional approval, and there are 2.5 per cent of the supplies which are not approved. Of the 1,836 supplies, 51.5 per cent receive some kind of treatment. It is estimated that about 75 per cent of all of the water supplies in the U. S. would pass the Treasury Department standard. Cross connections, inadequate treatment, poor supervision, open reservoirs, other possible sources of contamination, etc., were listed as the main cause of disapproval or provisional approval. Considerably less than one-half of the plants receiving provisional approval failed to meet the bacterial standard.

Numerical Rating of Public Water Supplies: E. S. Chase.—A single criterion of quality may fail to satisfactorily indicate the safety of the water. Some years ago the bacterial content of the water was the only standard for judging the quality. A scoring system which takes into consideration a number of factors is advocated as being a better means of judging the safety of the water. It also is an effective means of bringing about improvement in supplies which do not have a very high rating. The scoring system must be properly and tactfully used. The superintendent will find that a bad score frequently

Paul Hansen, chairman, Water Purification Division

will be very helpful in securing funds to make improvements. If the scoring system brings out the facts about the water supply it is indeed worth while. There are a few objections, the most serious of which is that arbitrary figures have to be used in scoring the supply. The objections are not insurmountable. A scoring system shows both the active and the potential sources of danger. The system proposed is mainly that adopted by the New England Water Works Association. The factors affecting the safety of the supply are, pollution hazards, measures adopted to protect the supply, and the quality of the water. Credit and penalties are set up, and a supply with a perfect grade will have a score of about 100. The system is a weighing of the factors affecting the quality of the water. The paper gave details of the scoring system and explained the factors which should be taken into consideration in determining the figure for each item on the list. **Wm. J. Orchard** stated that judiciously used, the scoring system may be used to stimulate competition in the betterment of water supplies. All arguments favor a scoring system, and he recommends that the rating system suggested by Chase be tried. **R. S. Weston** also recommended that the scoring system be tried. One of the discussors stated that the use of a scoring system for villages in the Birmingham, Ala., district resulting in improving the quality of the water. **C. H. Spaulding** questioned the need for a system of scoring and stated that it might be subject to mistakes and errors which would be embarrassing to some cities.

Progress Report of Committee on Standard Methods of Water Analysis: Jack J. Hinman, Jr., Chairman.—Mr. Hinman read what probably will be the last report of Committee No. 1, for it appears that this committee has been abolished. Mr. Hinman stated that the work of the committee has been hampered during the year by lack of knowledge of the intentions of the Committee on Water Works Practice with regards to the proposed representation of the American Water Works Association on the Joint Committee which was to be composed of three members of the American Public Health Association and three members of the American Water Works Association. Much of the report which deals with the work accomplished by the committee was taken up by explaining the work of the referees on bacteriological methods. **N. J. Howard** has carried on extensive investigations on the use of different peptones and their effect upon the rate of growth and the number of bacteria developing. Additional work also was undertaken by Mr. Howard on the isolation of the colon group by lactose broth, brilliant green bile broth, and Dominick-Lauter broth. In the raw and chlorinated Toronto water lactose broth appears to show no advantage over brilliant green bile and only slight advantage over the Dominick-Lauter broth. Much of the report on bacteriological methods centered around the use of brilliant green bile broth. Under chemical methods, chief interest seemed to be centered around the residual chlorine determination. **R. C. Bardwell,** in discussing the report, referred to the rapid methods of boiler water analysis which are to be included in the next edition of Standard Methods. These methods are not exact in some instances but are satisfactory for boiler waters. **A. M. Buswell** defended the present standards for residual chlorine determinations as being more accurate than the modifications proposed by Muer and Hale. Manganous salts in amounts up to 6.0 p.p.m. of Mn. have no effect upon the color produced by ortho tolidine. Discussion of the functions of the Joint Committee was started, but was stopped by H. E. Jordon's request that the committee be given a chance. Mr. Jordon is Chairman of the Joint Committee.

Report of Committee on Filter Media: John R. Baylis, Chairman.—The committee was organized during the past year to study materials used in water filter beds. Work at the present time is largely cooperating with the Committee on Filtering Materials from the American Society of Civil Engineers on a program of research they already have under way. The report gave an outline of the work under way at Detroit, Chicago and Harvard University on filtering materials. This work is in addition to that under way by the A. S. C. E. Committee, which has work under way in several cities throughout the country. **O. J. Ripple** discussed the use of anthracite coal in the place of sand for filter media. The 10 per cent size of the coal first used at Denver, Colo., was about 0.62 mm. diameter. Micro-organisms and coagulated matter passed through the filter beds. This coal was removed and a smaller size used. Ripple believes a bed composed of a layer of sand on the bottom and anthracite coal of larger size on top of the sand would make an ideal bed. **W. S. Mahlie** stated that sievings of 20 carloads of sand at the pit with unskilled labor compared favorably with the sievings made at the plant.

H. E. Jordan, secretary, Water Purification Division

Manganese and Its Relation to Filters: Perkins Boynton and **Lewis V. Carpenter.**—Manganese occurs in the waters in most of the bituminous coal regions of the east. Not much manganese is found in the coal itself nor in the slate adjacent to the coal beds. Unsterilized samples of shale gave up more manganese to water than sterilized samples. Streams in the vicinity of Clarksburg and Morgantown, W. Va., contain from 0.2 to 31.0 p.p.m. of manganese. The acidity of one stream was 30,000 p.p.m. In localities where the sand grains have a coating of manganese the manganese in the water ranges from a trace to about 7 p.p.m. A large amount of manganese was dissolved in one reservoir after the water was treated with copper sulfate. Mud balls and clogged places are quite common in filters where the water contains manganese. The manganese incrustation was removed from the sand grains at Luke, Md., with a weak solution of sulfuric acid. Manganese is usually removed from water by the lime-soda softening process, and it is removed by passing the water through zeolite beds. Manganese probably is present in water in the streams as a manganese carbonate. The water at Fairmont, W. Va., carried as high as 7 p.p.m. of manganese in

J. M. Wafer, assistant sales manager, Industrial Chemical Sales Co.

the recent drought. **R. S. Weston** stated that manganese, while seldom recognized in the past, is now being given considerable attention. At Baltimore and Providence the use of ferrous sulfate and lime to increase the pH above 9.1 removed the manganese. Mr. Weston thought it was better to use ferrous sulfate than chlorinated ferrous sulfate. **Arthur F. Mellen** stated that pronounced sand caking and clogging was not noticed at Minneapolis. The resolution of manganese by treating the water with copper sulfate was questioned.

Filter Problems in Connection with Water Softening: Charles H. Spaulding.—The problems in a softening plant are not necessarily more troublesome than the problems in other treatment plants. Algae interference with the lengths of the filter runs is unknown in softening plants, because the microorganisms are so thoroughly removed by sedimentation. The filter beds may pass coagulated matter at times the same as other treatment plants when a coagulant is used. Calcium carbonate forms sludge cake over the filter beds and it is difficult to remove by washing. Some pieces of the sludge cake become weighted with sand and settle to the bottom of the beds. If magnesium is present the cake is formed more readily. Calcium carbonate will deposit on the sand grains; however, the hardness removed from the water by such deposits more than pays for replacing the sand occasionally. The sand is more soluble in waters of high pH. Water stabilized to a pH of 8.8 will plate out calcium carbonate on the sand grains, and water treated with excess of lime and then carbonated to pH of 9.2 also will coat the sand grains. When the pH is above 9.2 the sand grains coat readily. The surface wash is used in one softening plant, and it keeps the beds in good condition. **D. H. Rupp** stated that the filters will unload their incrustation if water containing CO_2 is run through them. When activated carbon is added to the water the filter runs are shortened. **L. C. Billings** compared a treatment using milk of lime with a lime treatment in which part of the water was nearly saturated with lime and this part was then mixed with the balance of the water. About 7 g.p.g. of lime in the straight treatment reduced the alkalinity from 163 to 70, while with the split treatment the alkalinity was reduced from 198 to 47 with about 6 g.p.g. of lime.

Water Softening by Zeolite as Used in Municipalities: S. P. Applebaum and **L. P. Doane.**—Water softening for municipalities started about 1903, and there were about 110 municipal softening plants in 1929, practically all of which were lime-soda plants. Soft water has a definite industrial value to a city. A textile industry will never locate in a hard water district. Nearly all industries benefit from softened water. There are two methods of softening available—lime-soda and zeolite. Very hard water can usually be more economically softened with lime. Several municipal zeolite plants were described. The relative cost of plants for the two processes may be compared by comparing public bids on a recent plant. The water had a hardness of 20 to 25 grains and was to be softened to at least 4 grains. The bids for the zeolite plant were from $30,000 to $40,000 per million gallon daily capacity, and the bids on the lime-soda plant were slightly higher. Zeolite functions successfully on water of varying composition without skilled supervision, whereas it is essential to have a chemist for a lime-soda plant. One advantage of the lime-soda treatment is that the total solids are less. The Southern Pacific Railroad system have a number of zeolite softening plants. An automatic zeolite plant to handle a water of 22 grains hardness at Cedarville, O., was explained. **A. S. Behrman** felt that the author has gone too far in presenting the simplicity of the operation of zeolite plants. Perhaps in the majority of cases the lime-soda process would be more satisfactory. Some waters cannot be economically softened with zeolite. Zeolite softened waters are potentially corrosive, and there have been complaints of red water at one municipal zeolite softening plant. **E. S. Chase** stated that the sludge from a softening plant in England was burned and part of the recovered lime was used for treating the water. **E. B. Whitman** stated that a zeolite plant was installed at Cornell University so as to soften part of the water when the hardness was high. The two waters were then mixed. Inquiry was made if zeolite beds could be used for filter beds where the water was coagulated. **Mr. Crane** stated that he believed the coagulant would clog the pores of the zeolite. **J. T. Campbell** believed that the coagulated water could be taken care of with zeolite sand. **Mr. Doane** does not believe that zeolite should be used where the water is consistently turbid.

Experience with the Use of Powdered Activated Carbon: George R. Spalding.—Activated carbon is effective in removing practically all kinds of tastes and odors from water. Its action is by physical means. Tastes and odors due to algae are easily removed, 9.7 lb. of Nuchar per million gallons removed odors due to melosira and synedra. Some report that the use of activated carbon with alum reduces the amount of alum necessary to produce satisfactory water. Activated carbon may be used to decolorize water. It also may be used for deodorizing water mains. Fill the water main with water containing the activated carbon, let stand for a few hours, then flush the main. Activated carbon prevents the putrefactive decomposition of sludge in settling basins. The lime sludge accumulating in a clear water reservoir as a result of the treatment to prevent corrosion was odorous when the water was not treated with carbon and was odorless when the carbon was used. Sludge treated with activated carbon will not undergo further decomposition. Thorough mixing of the carbon with the water is essential. **Alfred Echert** found that 40 to 45 lb. of carbon per million gallons were required at Saginaw, Mich. **J. E. Kerslake** stated that activated carbon was effective in removing color from water and that the saving in alum was one-half to three-fourths the cost of the carbon. It also stopped the passage of colloidal alum through the filters in the winter months. **W. H. Lovejoy** tried activated carbon for removing a very objectionable musty odor at Louisville. Ten pounds per million gallons, costing $0.50, was effective, and there was no appreciable shortening of the filter runs. **H. E. Moses** stated that activated carbon was very effective in removing the musty river taste in the waters of western Pennsylvania during the drought.

Present Status of Aeration: Frank E. Hale.—The removal of objectionable odors from water is the chief function of aeration, though it may be used to remove other dissolved gases such as carbon dioxide. Frequently it is to add dissolved oxygen to the water which will oxidize certain dissolved compounds. The methods of aeration are: direct exposure of the water to air in streams and reservoirs, cascades, trickling

over coke or other such materials, sprays, and air forced or drawn into the water in the form of fine bubbles. Hydrogen sulfide is readily removed from water by aeration and chlorine may be reduced below troublesome limits. Musty and unpleasant odors from decomposition are removed, and odors from microscopic organisms are greatly reduced by aeration. The odor produced by synura is not removed, and the odor due to the action of chlorine on organic bodies also are not removed. Odors due to trade wastes usually are not removed. In some instances aeration assists coagulation. Aeration is essential in the removal of iron and manganese, and it assists in reducing red water by reducing the CO_2. Sixteen hundred aerators at the Kenseco Reservoir spray the water 30 ft. into the air. The CO_2 is reduced from 2.0 to 0.7 p.p.m. The CO_2 at the Rye Dyke aerator is reduced 40 per cent. **W. H. Lovejoy** stated that there was an increased interest in aeration. **J. F. Bartuska** finds that gasoline tastes are reduced by aeration, and **N. J. Howard** stated that aeration was effective in removing chlorine from water.

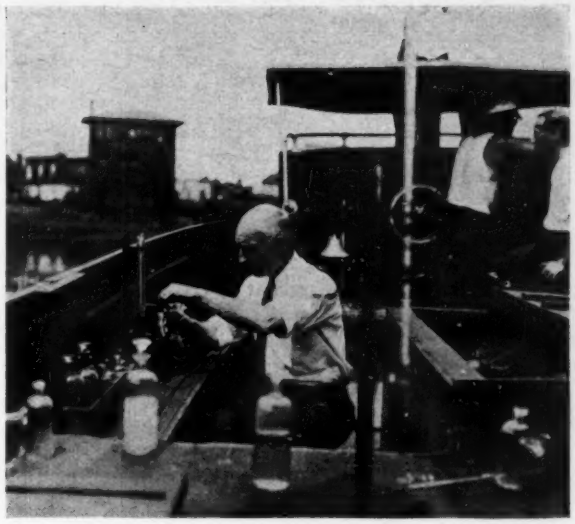
Floc Formation and Mixing Basin Practice: George E. Willcomb.—The author does not believe that the term "mixing" is appropriate and prefers to use the term "conditioning." The most rapid floc formation occurs at a definite pH, which may vary for different coagulants. After the first fine coagulation forms the problem is to bring the small flocculated particles together into larger particles of floc. The early plants were generally subjected to improperly conditioned water. The lower the temperature the longer is the agitation required. A method for measuring the floc which settles out was described. An appreciable saving of coagulant may be made by mixing from 20 to 30 minutes. There was less alumina passing the filters when the water was properly conditioned than there was when it was not properly conditioned. The different types of mixing basins are baffle type, mechanical stirrers, spiral flow, compressed air, and aer-o-mix. Baffled basins are as economical as any, though mechanical agitation is better adapted where a low head is available. R. G. **Yaxley** described the effect of introducing compressed air into the water, and **George B. Prindle** described the mechanical mixing basin in the Highland Park, Ill., plant. **M. C. Smith** stated that marked economy could be effected by recirculating part of the sludge.

Report of Committee on Taste and Odor Control: Martin E. Flentje, Chairman.—A brief report was presented outlining the work which will be undertaken by the committee. It also briefly described existing taste elimination methods, and stated that an effort would be made to perfect a better method for evaluating tastes and odors. **H. H. Gerstein** stated that the method of recording tastes and odors given in Standard Methods of Water Analysis was totally inadequate. He favored the Spaulding method. **C. G. Spaulding** described his method of determining the threshold point by diluting with odor-free water. **F. E. Stuart** described a comparator for determining the threshold point. He suggested pasteurizing the mouth with hot distilled water before making taste and odor tests.

Cross Connections with Public Water Supplies.: Samuel B. Morris.—The paper was confined almost entirely to danger of pollution from plumbing fixtures. All plumbing fixtures should be arranged so that the water cannot be sucked back into the pipes in case the pressure is cut off. Direct toilet flushing fixtures undoubtedly constitute the greatest hazard. Several instances were related when the content of the toilet bowl was sucked back into the pipes. The author recently observed the contents of a toilet bowl in a high class hotel sucked back into the water line due to a heavy draft on the water pipes in the vicinity of the hotel. A plumber cut off the water to fix a leak on the second floor of a building and was surprised to find upon returning to the second floor that the water in the toilet bowl had been sucked back into the water line. An attendant connected a garden hose to a sewage pump for priming, and when the pump was started sewage was forced back into the water line. The author stated that he did not know of a serious outbreak of illness as a result of polluted water being drawn back into the water pipes, but such an occurrence was possible. No connection should be made except in a manner which will prevent back-flushing. Water mains should not be allowed to form a vacuum when shut off. **A. E. Gorman** stated that check valves on lines leading to toilet flush valves is a very good safeguard. The data on pollution from plumbing fixtures should be taken to the manufacturers of plumbing goods and an effort made to enlist their support in preventing the installation of dangerous fixtures. **E. S. Chase** said that cross connections to polluted supplies should not be allowed.

Use of Iron and Lime in Removal of Manganese: Malcolm Pirnie.—The treatment to prevent red water in distribution systems may cause black water of manganese when the water contains considerable manganese. Lime was first added to produce a pH of 8 to 9, at Providence, R. I., but was reduced in 1930 to pH of about 8. Corrosion increased, and it was found impossible to obtain satisfactory water on some of the dead ends without bleeding. The black sediment was the first evidence of manganese in the distribution system. Ferrous sulfate and lime were effective in removing the manganese. 1.4 g.p.g. of iron and 1.0 to 1.25 g.p.g. of hydrated lime were found to be satisfactory. This increased the pH to about 10.0. Manganese requires a pH of 9.2 to 9.6 to be precipitated, and best results are obtained when the pH is about 10. The manganese was removed completely by the treatment at Providence. **P. W. Frisk** stated that the lime and iron treatment was not suitable for certain industrial waters such as is used in the textile and rayon industry.

Unsuspected, Unusual and Little Known Factors in Water Supply Quality: Paul Hansen.—The war on cross connections started with the typhoid outbreak at Lowell, Mass. Several unusual instances in which water supplies have been polluted were described. Some of the defects of filtration plants are common wall between sedimentation basin and clear water reservoir, roof drainage into the filters, and sometimes the wash water discharge line passes through the clear water reservoir. Filters out of service may impart taste and odor to the water when they are turned back into service. The use of the roof of a clear water reservoir by a contractor's men caused urine to get into the water through a leak in the roof. Manganese is prominent in producing trouble, and flourine has been credited with causing mottled teeth.



The Author and His Floating Laboratory During Tests of Coney Island Creek Water for Hydrogen Sulphide Content (See Fig. 2)

SODIUM NITRATE USED TO CONTROL NUISANCE

By WILLIAM T. CARPENTER

Chemist, Department of Sanitation, New York City

CONEY Island Creek is one of the vilest bodies of water in the United States. Gravesend Bay, lying between The Narrows and the West End of Coney Island, narrows down until it becomes a narrow estuary. Originally this creek formed a connection between Sheepshead Bay and New York Bay, making the famous amusement resort an island as its name indicates. In the course of years the central portion was filled and the creek became almost landlocked, and if one ascends from the mouth, in less than a mile it will be noted that it is too shallow for navigation except by rowboat, and soon this too becomes impossible, and the estuary becomes only a number of swampy ditches. (Fig. 1.)

Into this bayou pours about six million gallons of sewage daily beside some industrial waste from a gas plant located on its bank. This mass of filth oscillates up and down stream with the changing tide and is but slowly forced out into Gravesend Bay and oxygenated water. The south side is thickly built up, in some places to the very bank. Luna Park, entertaining thousands daily during the summer, is separated from this open sewer by little more than the width of Neptune Ave.

Some effervescence from the creek bottom can be observed in the coldest weather and the water is seldom free of measurable quantities of dissolved hydrogen sulphide. With the advent of warm weather, at the time when the largest crowds visit the Island, the hydrogen sulphide in the air near the creek becomes sufficiently concentrated to blacken lead paint, and the stench becomes intolerable.

The warm dry summer of 1930 produced such unpleasant conditions that the Department of Sanitation was in receipt of complaints from the residents and demands that something be done to alleviate the situation, in response to which the writer was directed to report on possible means of relief.

The bad state of the creek had been recognized for some time and plans for the complete removal of sewage had even then been completed, but it was realized that these plans could not be carried out at once and some sort of temporary palliative would have to serve during the interval. The Chairman of the Commission, Dr. William Schroeder, Jr., directed the Division of Engineering to report what could be done along these lines. On the basis of experience in treating the Neponsit River in Massachusetts with sodium nitrate, it seemed possible that some improvement would result in the conditions at Coney Island if similar work were undertaken there. The writer, in his report, urged that an experimental run be made during the worst part of the summer of 1931. Mr. R. H. Gould, Engineer of the Department concurred in the report, which was thereupon presented to the engineer member of the Commission and upon presentation of this report to Chairman Schroeder he immediately authorized the purchase of ten tons of sodium nitrate and several tons of chlorinated lime for this purpose; although much of the latter was later used elsewhere.

By August 6th the chemicals had been delivered and all was in readiness to start the trial. With the small quantity of ammunition available, it was thought wiser to concentrate on the worst "sector" near the mouth rather than scatter it over the length of the estuary. Furthermore, it was hoped that by strewing chlorinated lime over the surface of the water we should be able to neutralize much of the hydrogen sulphide and to *prevent* further excessive development of this gas by applying sodium nitrate.

Accordingly, one ton of the hypochlorite was strewn over the surface of the water for a thousand feet more or less, and as uniformily as possible. This, however, was not very uniform, and it is highly probable that the bottom of the creek was irregularly covered with lumps of chlorinated lime with dry centers.

The use of nitrate was then started. It was applied in solution from some liming tanks which had been designed for this purpose. The dosage was in the quantities of 1,000 lb. evenly distributed to the sewage through each flood tide, rather than continuous application on both tides, this scheme being chosen to prevent the loss of nitrate into the bay.

As soon as the chlorination was completed the more optimistic of the observers claimed to be able to note an improvement in the odor and appearance of the water; but by the next morning no one who had seen the conditions previously could fail to see the change for the better. The inky blackness of the day before had given way to a brownish color, and effervescence had notably diminished. The odor had not entirely cleared up but certainly was less than on the day previous.

Quantitative measurements of the dissolved hydrogen sulphide had been started several weeks previously and were continued until the experiment had been finished for some time. (See Fig. 2.)

On July 14 and 15 the average values for the dissolved hydrogen sulphide in the lower stretch of the creek had been 8.4 and 9.5 parts per million respectively. By Aug. 6 the amount had risen to 16.5 p.p.m. The chlorine treatment reduced this to 12.7 within an hour, and on the

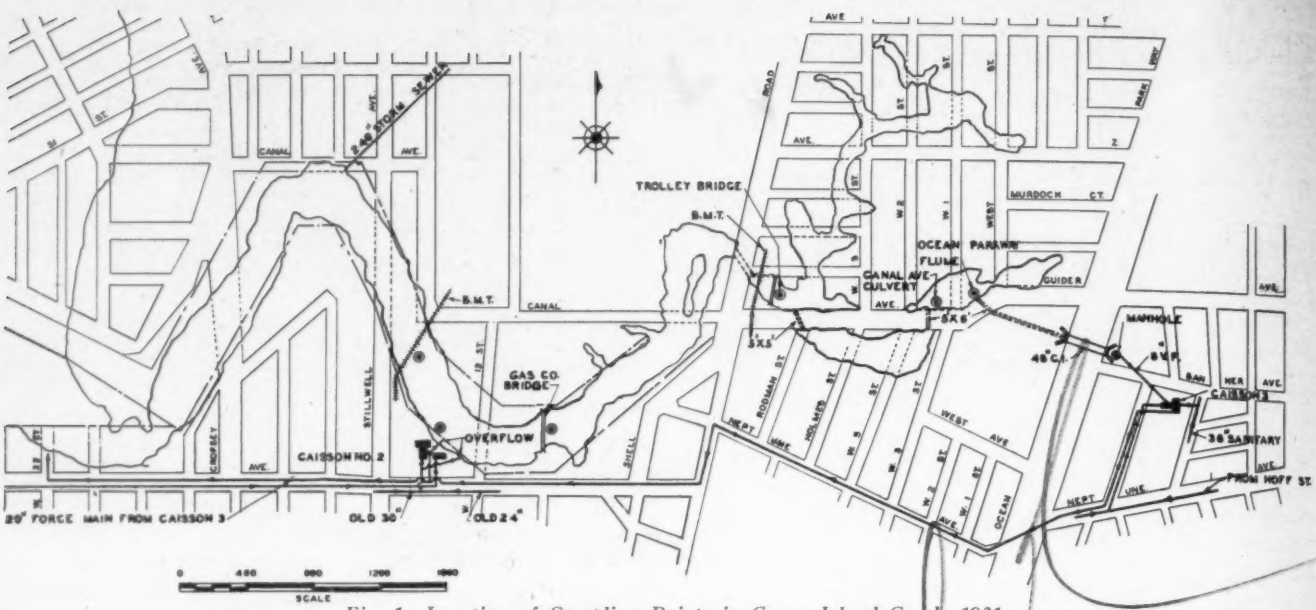


Fig. 1—Location of Sampling Points in Coney Island Creek, 1931

morning of the 7th the average value had fallen to 10.8, and it continued to fall regularly until the 14th when it it was but 6.5. The nitrate treatment had been ordered stopped on the 11th, but due to misunderstanding, the night shift continued the treatment for two days longer resulting in a half dosage. When the treatment was finally stopped completely, the dissolved hydrogen sulphide rose to 9.3 p.p.m. on Aug. 18th.

On Aug. 18th it was decided to remove the scene of operation to a point at the upper reaches of the creek where conditions were less severe than at the point near the mouth.

Here, instead of strewing the hypochlorite on the surface of the water previous to starting the nitrate dosage, it was made into a cream in an old liming tank, and pumped into the creek at the time when the tide turned from flood to ebb. The amount of hypochlorite was 1,300 pounds, and the amount of nitrate was 1,000 pounds applied on every other ebb tide, these amounts being about half those used in the previous experiment.

The results at first (Fig. 2) were not as clear-cut and decisive as those described above, but before many days had elapsed, the benefits were unmistakable, and on Aug. 25th the entire upper reaches of the creek had become milky white and the water was devoid of odor. Even the mud banks exposed at low tide seemed to be deodorized. The dissolved hydrogen sulphide at the point most remote from the point of application of chemicals rose from 7.3 p.p.m. on Aug. 18th to 8.3 on Aug. 20th, then fell steadily to a minimum of 3.2 on Aug. 27th. The two other sampling points in the area gave results which showed general decrease to the 25th when they showed total elimination of the sulphide. On this date, the supply of nitrate was used up and the figures steadily mounted until Sept. 1st, when observations were discontinued. On Sept. 1st, the lower section of the creek was examined again and it was found that the average value had fallen from 9.2 on Aug. 18th to 7.8. It seems reasonable to ascribe this to the nitrate applied in the upper creek which gradually worked its way toward the bay.

The unmistakable lowering of the hydrogen sulphide content of the water and the accompanying reduction of odor accomplished by the use of ten tons of nitrate in about two weeks of application has encouraged the Department to try the experiment on a larger scale during the summer of 1932. Seventy-five tons have been purchased which will enable the full dosage to be maintained from July 15th to Sept. 15th approximately.

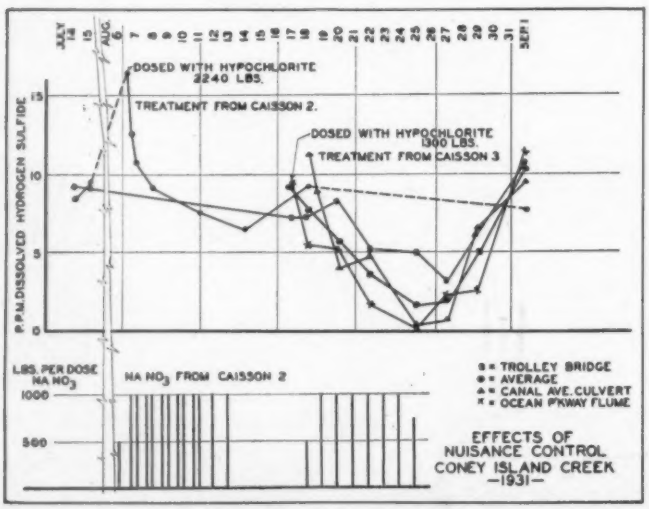

DOSED WITH HYPOCHLORITE 2240 LBS.
TREATMENT FROM CAISSON 2.
DOSED WITH HYPOCHLORITE 1300 LBS.
TREATMENT FROM CAISSON 3
P.P.M. DISSOLVED HYDROGEN SULFIDE
LBS. PER DOSE NA NO3
NA NO3 FROM CAISSON 2
● = TROLLEY BRIDGE
■ = AVERAGE
▲ = CANAL AVE. CULVERT
× = OCEAN P'KWAY FLUME
EFFECTS OF NUISANCE CONTROL CONEY ISLAND CREEK —1931—

Fig. 2—Effects of Nuisance Control, Coney Island Creek

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FOUR STATE SECTION A. W. W. A. TO MEET IN JUNE.—The 1932 annual meeting of the Four State Section American Water Works Association will be held June 7 and 8 at the Hotel Madison, Atlantic City, N. J. Charles H. Becker, 400 Chestnut St., Philadelphia, Pa., is Secretary-Treasurer.

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NEW IRON REMOVAL AND SOFTENING PLANT FOR LANCASTER, O.—C. P. Hoover, Consulting Chemical Engineer, Columbus, Ohio, is designing an iron removal and zeolite water softening plant for the City of Lancaster, Ohio. The plant will cost approximately $75,000.

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DEAN MARSTON RETIRES—Dr. Anson Marston, dean of engineering at Iowa State College, Ames, Iowa, will retire from his administrative duties June 30. He will be succeeded by Prof. T. R. Agg, assistant dean of engineering. This change was announced recently by R. M. Hughes, president.

SEWAGE TREATMENT IN UNITED STATES—

COMPARED WITH THAT AT LOS ANGELES EXPERIMENTAL STATION

By R. F. GOUDEY

Sanitary Engineer,
Department of Water and Power,
Los Angeles, Calif.

Part II.

THE need is great of correlating authentic design data determined from actual operation experience and satisfying all chemical and biological requirements essential to the activated sludge process. The present method of design is that of following precedent which is frequently outworn. Engineers in general design the plants only to have the operator criticize design features and change original construction. Sewage was aerated in jars with 15 per cent sludge in the famous Lawrence experimental work and engineers still design continuously operated aeration tanks on the same sludge return basis. Then the operator comes along and finding that the sludge return must be 30 per cent and at times 40 per cent, he installs pumps of that capacity. Aeration periods instead of being six hours are thereby cut to less than five hours. Pipe capacities are usually found too small. Chemists have reported no improvement in reaerated sludge over non-reaerated sludge, and consequently no provision for reaeration has been made in subsequent plants. Both the operator and the engineer in such cases are not aware of the wonders that sludge reaeration can do from the biological side of the process. Flexibility in various steps of the process is impossible in most of the plants which have been dogmatically arranged.

One of the objects of our study at the Los Angeles Experimental Station is to avoid past errors and develop new methods and design. Every feature in the design of an activated sludge plant has been carefully scrutinized, hypotheses have been tried out on large scales, careful physical, chemical, microscopial and bacterial control has enabled us to tell the value and significances of the changes in design or operation which prove successful. This work is rapidly leading to the production of a super-activated sludge process. It is one in which the sludge during reaeration is adjusted to the proper ratio of bacterial and protozoal life in reference to food supply, one in which chlorine plays an important part in liberation of enzymes, one in which pH is carefully watched in the incoming sewage, one in which bulking of sludge is of no concern whatever, and one in which the oxidation requirements are more carefully watched than elsewhere. All of these and other features have actually been successfully tried out for over a year at our experimental plant.

The value of an inspection trip to eastern plants* was, to a great extent, corroboration of our own views and in obtaining support for lines of activity initiated by ourselves.

Screening

Automatically operated and mechanically cleaned bar screens were found at eight of sixteen plants which used bar screens. Bar screens should be an integral part of every plant.

Fine screening equipment no longer has a legitimate use because higher removals at very little additional expense can be obtained by preliminary sedimentation.

Preliminary Clarification

Preliminary clarifiers have now reached 60 per cent removal of suspended solids with settling rates of 965 gal. per square foot per day and this checks our experience of obtaining 80 per cent removal by employing a settling rate of 615 gal. per square foot per day. The stronger the sewage the greater the removals, but the latter also is directly a function of the settling rate. It must be remembered that preliminary sedimentation is the cheapest method of solids removal and the development of its efficiency to a maximum is but logical. In our experiments we propose to chemically coagulate settled sewage with ferric chloride ahead of aeration tanks and recirculate the chemical sludge over and over again except for a small withdrawal to assist in thickening primary sludge before it is pumped to the digestor.

Preaeration of sewage with 0.04 cu. ft. of air per minute ahead of sedimentation as at Grand Rapids, undoubtedly insures better sedimentation. The incorporation of preaeration in a grease removal tank is a worth while development.

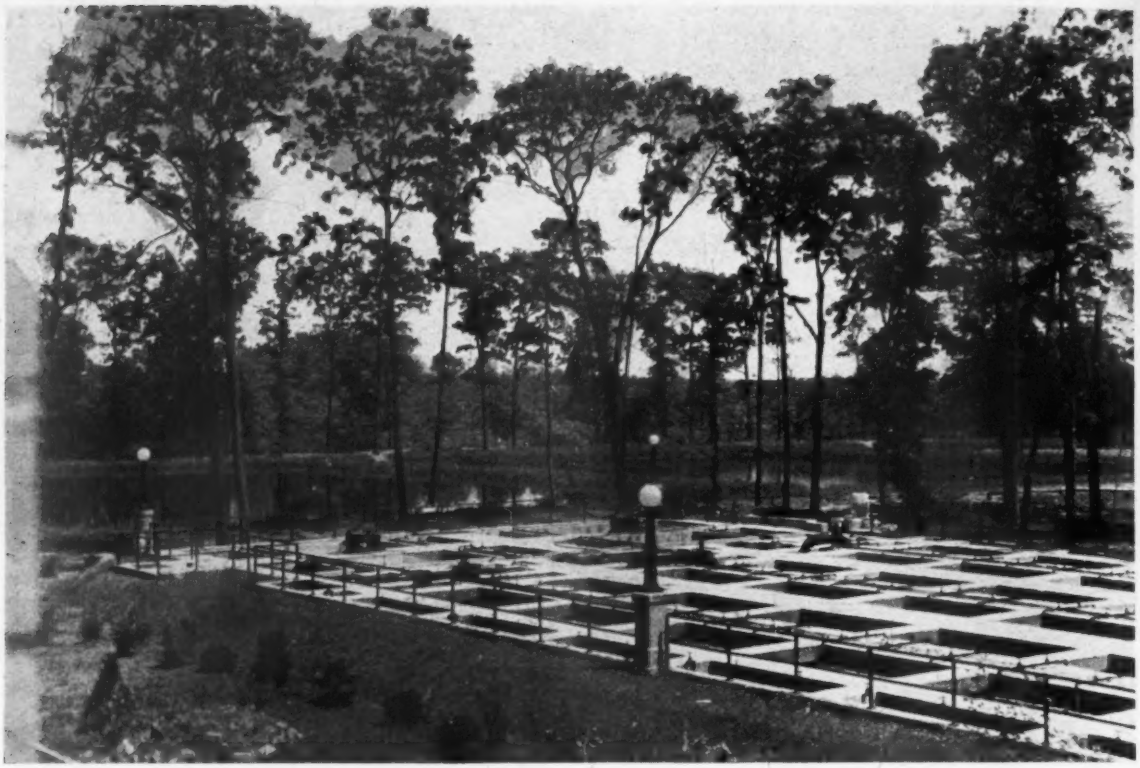
Only clarifiers of relatively small size have yet been constructed. Baltimore has under erection, two 140 ft. traction clarifiers and the increased use of large clarifiers is certain to occur.

Sewage Aeration

Methods used for aeration in the east vary in efficiency. In general, the Manchester type of aeration has superseded the ridge and furrow method. The addition of air from porous Alundum tubes half way down the tanks has been provided at two plants, but it would appear that larger amounts of air are thus far required to get oxidation and agitation than is the case with other methods. Horsepower requirements for all types of plants based on each million gallons treated vary from 25 to 65. None of the eastern plants have developed as efficient a method of aeration as that used at our Griffith Park plant, and tested out also by the Chicago Sanitary District. The scheme includes compressed air from filtros plates and paddles operating against the air which prolongs the contact of the air with the sewage. This latter factor is far more important than ordinarily considered. The power required has been, on the average, 15 hp. per million gallons.

Other methods of aeration which we are experimenting with include buckets on paddles as tried out on a small scale at Tenafly, use of air lifts in center of aeration tanks and aeration from rotors of the Genter type. The latter method allows for the discharge of compressed air through a revolving perforated rubber cylinder with 250 holes per square inch, which not only gives very fine bubbles at low losses, but also provides

*Covered in Part I of Mr. Goudey's article which appeared in Water Works and Sewerage, March, 1931.



Sewage Treatment Plant at Rockville Center, L. I. Activated Sludge Process. Final Effluent Is Spread on Sandy Areas and Seeps Away. Sludge Gas Is Used to Operate Gas Engines.

for mechanical agitation which is cheaper than agitation with compressed air. It is not rash to predict that, with sewage given preliminary sedimentation, which results in production of an activated sludge easy to keep off the bottom of aeration tanks, many novel and far more efficient devices for aeration will be forthcoming, to the end that the cost of operation will be still further reduced.

There is justification for shortening the detention period to four hours using 35 per cent returned sludge, *provided the activated sludge is maintained in proper condition.* As a matter of fact, we get nitrification at the end of two hours aeration with the super activated returned sludge that we employ, and if the success attained in our past year's operation continues, we will shortly be ready to recommend two hours' aeration. This will mean a big saving both in installation and operation costs.

Many plants now maintain 1,500 to 4,000 p.p.m. of suspended solids in the aeration tanks, and four plants visited were actually returning 40 per cent sludge in order to maintain the best solids concentration. We find with our type of sewage that best results are obtained with a suspended solids concentration varying from 1,000 to 2,000 p.p.m.† and a sludge return of 35 per cent.

The use of deep tanks at Chicago and Peoria appears justified not only from the saving in installation cost at the sacrifice of extra power for compressed air, but principally because of the added time of contact which the air released from the filtros plates has before it escapes from the surface. Our indications are that lengthening the time of air contact, even though slight, is of great significance and warrants additional power necessary to secure it. We believe that the excellent results at Chicago North Side Plant with 0.6 cu. ft. of air per gallon can thus be explained.

†*Editor's Note*: The upper figure has been found more universally satisfactory than the earlier experience at eastern plants indicated.

Reaeration

At no eastern plant visited was reaeration employed. Little wonder that such plants suffer upsets in operating efficiency when shots of unusual sewages reach them. The sludge is returned in the "sickest" state of its cycle to do its hardest work.

We reaerate returned sludge after partial sterilization to kill off the excess bacteria and to release their enzymes. New growths of organisms appear which, in turn, strengthen the protozoa. Further, we actually dilute the sludge with final effluent to the point where good flocculation occurs when the sludge so conditioned is returned to the settled sewage for aeration. Judicious use of lime also assists in maintaining a good sludge.

One reason for laying stress on enzyme action is based on the hypothesis that enzymes are responsible, first, in making atmospheric oxygen available to organic matter and, second, in rendering the organic matter receptive to the oxygen. The fact that our plant has operated an entire year without the sludge bulking to where it rises up and passes over with the effluent is an indication that reaeration of the nature we employ, even though we are yet unable to prove the theory involved, is nevertheless of much practical value.

Final Sedimentation

All activated sludge plants are now equipped with mechanical clarifiers designed on a basis of 1200-1800 gal. per square foot of surface area per day. Eight plants were equipped with square clarifiers, four with round tanks and four (old plants) had oblong tanks. There seems to be some evidence that the square tank produces the best results. The question of tank inlet and outlet arrangements has not been approached from a practical analysis of the factors at work and needs

more than experimental study by trial and error methods.

Chicago, at the North Side Plant, has changed cross flow tanks to provide inlets from two opposite sides and outlets from three weirs placed across the middle of the tanks. Far better results have been secured. Peoria has extended the weir outlet at one end of the tank along both adjacent sides some distance toward the inlet side. Rockville Center has virtually made its clarifiers into upward flow tanks. At Los Angeles we appreciated that settling activated sludge is entirely different from settling fresh sewage. The sludge wherever admitted to the clarifier, provided it is near the bottom, forms a blanket of equal depth all over the bottom. It does not build up on one side of the clarifier as is the case with crude solids. The clear water consequently is immediately over the sludge blanket. Hence the greater the number of weir outlets over the entire surface of the tank the clearer will be the final effluent. Restricted weir outlets at one end of the tank, and especially in long narrow clarifiers, invariably cause currents which carry light sludge particles out with the effluent. Many clarifiers were noted to have speeds of mechanism sufficiently high to disturb the sludge blanket. In short, clarifiers should be designed along lines of upward flow units.

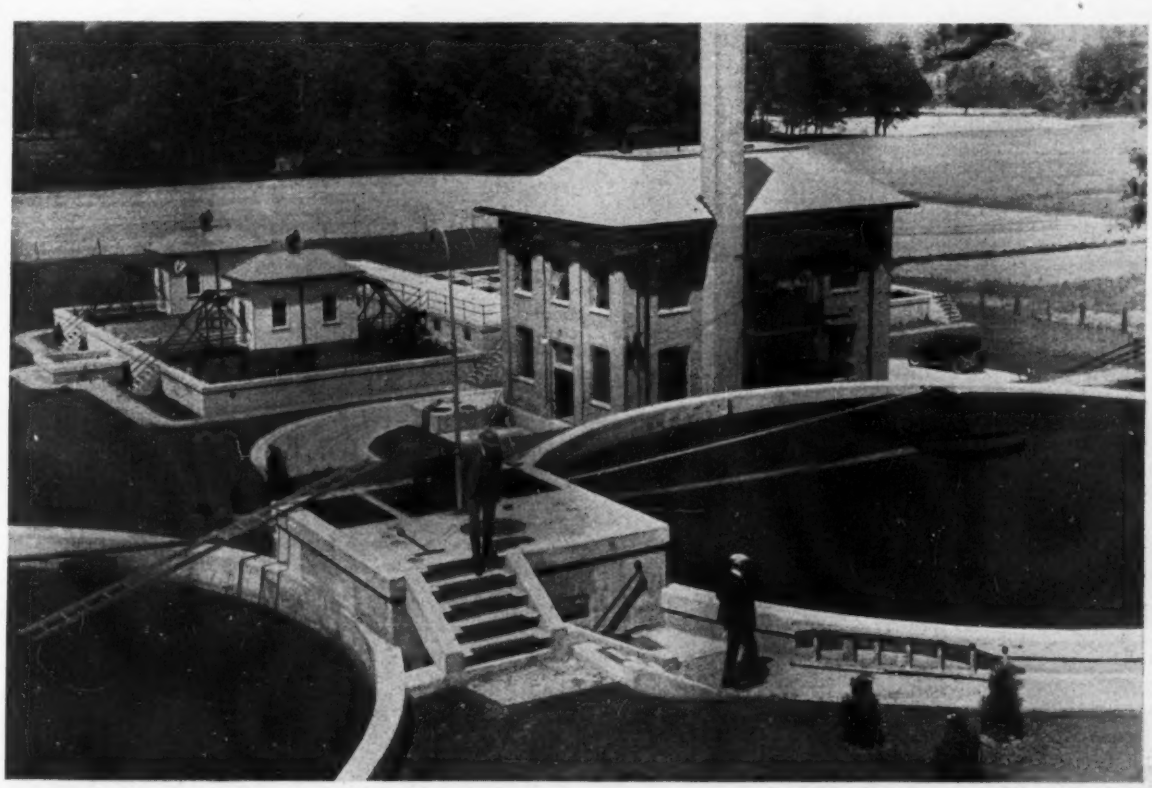
Many of the plants visited were operating on sewage flows much lower than their designed capacity and in such cases far better results were being obtained with actual settling rates of 500 to 700 gal. per square foot per day. In our case we employ double sedimentation with the last clarifier designed on a basis of 550 gal. per square foot of surface area per day. This more conservative basis of design, together with adequate weir outlets covering the entire surface of the tanks, accounts for our having gotten away from light particles of sludge appearing in the final effluent. Double sedimentation is justified if effluents of uniform quality must be obtained. Not only does it provide useful flexibility, but should sludge rise in the first clarifier for any reason, such as stoppage of sludge pumps, power interruption, or washing down of tanks, it will be intercepted in the final clarifier. Our final clarifier content is clear enough to permit observation of the action of the squeegees through 7 ft. of water, yet the sludge it removes is measurable. The second clarifier also provides a good contact period for chlorination and the sterilized sludge does not rise from the bottom.

Sludge Digestion

The use of heated sludge digestion tanks constitutes the best method of sludge disposal for the activated sludge process. These have, in the past three years, been provided at five activated sludge plants but none of them have made their operation as simple as ours. Some plants return overflow liquor into the raw sewage with disastrous results, and most of them pump excessive and needless amounts of thin sludge to their digestors. There is, apparently, no uniformity in designing the capacity of such digestors.

The largest digestors in use are 85 ft. in diameter, which is about the limit where the stirring mechanisms are supported from trusses. New designs are now out using center supports which will permit diameters of digestors up to 150 ft.

Our conception of a digestor is one designed to retain the actual volume of sludge pumped to it for 30 days, and to provide an automatic discharge of digested sludge equivalent to the pumping in of fresh sludge. This does away entirely with overflow liquor. For convenience the displaced digested sludge from the digestor is allowed to accumulate in a holding tank until the volume is sufficient to discharge to the sand beds. The only sludge pumped to the digestor is that obtained from the primary clarifier. It is fresh sludge consolidated with recoagulated excess activated sludge



Sewage Treatment Plant at Elyria, O., Activated Sludge Process. Sludge Digestors in Foreground.

in small amounts. It has a water content varying from 92 per cent to 94 per cent. After digestion the water content varies from 94 per cent to 96 per cent, with 20 per cent actual decrease in volume.

The consensus of opinion on temperature is that 90 deg. F. gives the best gas production and a sludge easy to dewater. Thermophylic digestion of sludge is being urged in some quarters, but large scale work on one of the digestors at Aurora is reported to be unsatisfactory. Our experience over a six months' period on a 20 ft. digestor was that a temperature of 125 degrees gave less gas production, a very foul supernatant liquor, and a frightfully odorous sludge, difficult to dewater, and when put on sand beds attracted flies. It had to be given up in self defense to prevent nuisance and it took three months to re-establish normal digestion.

Gas Production and Utilization

Gas production varies from 1.0-1.5 cu. ft. per capita or 10 to 15 cu. ft. per pound of volatile matter digested At our plant this value is 16 cu. ft. per pound of volatile solids destroyed. The B. T. U. value of sludge gas is fairly uniform at all plants, namely about 700

Only at three plants were seen any efforts to utilize gas for power production. Charlotte, North Carolina has two gas engine installations, one being a 225 horsepower Sterling engine direct connected to an air compressor and the second is a 75 horsepower engine direct connected to a sewage pump. In spite of the high speed of the Sterling engine very good performance has been obtained. The engines are not used now as it is cheaper to run on electricity. Rockville Center, L. I., does good work with power utilization. It has two power installations, one is a four-cylinder Buda engine direct connected to a 400 to 800 cu. ft. per minute blower, and the other a six-cylinder Buda engine operating a 25 KVA generator. Both units operate during the day, averaging over eight hours actual running time for a nine months period. Except for changing spark plugs every six weeks and grinding valves occasionally, no engine trouble has been experienced. It appears more practical to operate the compressor rather than the generator because variable speed causes no trouble in compressor operation.

Our experiments, operating different sized generators on a Ford engine, indicate that the gas could be used to best advantage in a two cycle engine which has nothing to get out of order and that it should be direct connected to pumps or blowers. In generating electricity the high speed gas engines used seldom reach 15 per cent efficiency, 15 per cent is lost in the generator and another 15 per cent is sacrificed in the motor driving a useful unit. With a two cycle engine 20 per cent efficiency can be obtained with only 5 percent loss for transmission of power to direct connected units. We have actually operated our entire plant for a time on power generated from gas and believe that it can be used continuously to advantage in a large plant

Sludge Disposal

In the small activated sludge plants glass covered sand beds are provided. Greater area is required than that for sprinkling filter plants because of the greater removal of suspended solids. About 1 sq. ft. per capita is what the activated sludge plants equipped with them were actually operating at. Two plants, Grand Rapids (separate sludge digestion only) and Peoria have found it cheaper to build storage tanks to hold over winter sludge for drying in the summer. Grand Rapids has a covered reservoir 110 ft. by 220 ft. by 20 ft. depth with sloping sides, whereas Peoria has two 130 ft. diameter tanks 32 ft. deep. Although this is undoubtedly a strategic move, neither method, namely drying under glass or storage until summer, proves best for our conditions.

Our answer to the sludge disposal problem is that of dewatering and drying digested sludge for use as a fertilizer. Experiments on different types of vacuum filters have definitely established that the digested sludge can be dewatered to produce a cake of 65 per cent to 75 per cent moisture, depending upon the amount of heat and coagulant applied, and can then be dried to 10 per cent moisture in a low temperature oven at a cost less than open sand bed drying. The sale of the dried and sacked sludge for fertilizer at the present low market prices will more than pay the cost of sludge handling. The nitrogen value of the dried sludge varies from 3.5 per cent to 4.5 per cent.

We are inclined to believe that the best method of sludge utilization is the one adopted at Charlotte, North Carolina. At their Sugar Creek Plant digested sludge is sold to a fertilizer contractor. This contractor dries the sludge to 10 per cent moisture, grinds it and then fortifies it to produce a high grade fertilizer with 8 per cent nitrogen, 3 per cent potash, and 7 per cent phosphoric acid, which is sold for $100 per ton. In California, synthetic fertilizers using digested sludge for a base and fortifying it to raise the nitrogen content to 10 per cent can be produced at low cost and be marketed to advantage.

Conclusion

In general, eastern plants have improved in architecture and operating results have definitely shown that the activated sludge process, crude as it is, usually surpasses sprinkling filter treatment.

At the Griffith Park Experimental Station the activated sludge process has been developed to a point of efficiency which, for less cost than at eastern plants, produces a better effluent. The by-products, consisting of power from digestor gas and fertilizer from digested sludge, have proven that the former is sufficient in amount to operate a properly designed activated sludge plant and the latter will return sufficient revenue to pay for all costs in conditioning, filtering and drying the digested sludge.

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On Water Purification*

The water purification group has everyone agog
Because it is the bumptious tail that wags the blooming dog.
To be just once its chairman is an honor, to be sure,
But getting up the program—that's something to endure.
Doc Tonney's got the bugs lined up that indicate pollution;
Tarbett of the P. H. S. submitted a contribution
And tells us if our water works are strictly up to snuff;
Chase says we should grade them, tho' we treat them rather rough.
Hinman reports on standards for committee number one;
Baylis reports on filter sand and tells us what he's done.
Boynton writes on manganese and how it gives him troubles,
Spaulding tells of cleaning sand with CO_2 in bubbles.
Lawrence keeps his filters clean by washing at high rate;
George Spauldings tells of carbon use strictly up-to-date;
Wilcomb gives on mixing tanks the latest bit of dope;
Morrill on settling basins covers quite a scope.
Flentje as the chairman reports on smell and taste,
Morris tells how cross connections ought to be effaced.
Pirnie takes out manganese with just a little lime,
And so we fill the total allotment of our time.
Then the meeting has an ending for 1932
Which constituted the chairman's final exit cue.

*The program of the Water Purification Division at the recent convention of the A. W. W. A., expressed in verse by Paul Hansen, Retiring Chairman 1932, and which he termed his "Swan Song" at the Purification dinner.

OKLAHOMA WATER AND SEWAGE SHORT COURSE

Report of Eighth Annual Meeting

By H. E. SCHLENZ

Sanitary Engineer, Chicago, Ill.

H. J. Darcey
Chief Engineer,
Oklahoma State
Health Department

THE Eighth Oklahoma Water and Sewage Short Course held at the Oklahoma A. and M. College at Stillwater, Okla., on April 12 to 16, was preceded by an extensive inspection trip made by 45 of the 83 members and guests who attended the meeting. This inspection trip of about 340 miles started at Claremore and in a two-day period, the plants of Chelsea, Vinita, Miami, Grove, Tahlequah and Tulsa were visited.

The meetings were conducted in the nature of a school for sewage and water treatment plant operators. A very full program was provided for the first three days, followed by two days of classes in sanitary engineering prepared to give the operators some practice in making chemical analyses, and to provide further training in the fundamentals of operation.

H. O. Delzell* of the Portland Cement Association, opened the sewage session with an appropriate paper on **"Sewage Disposal and What It Means to Public Health,"** stating that due to the receding flow of many of our streams, the ordinary amount of contamination is magnified, necessitating the supplementing of the natural means of purification with sewage treatment processes. In times of financial stress when people look upon bond issues with disfavor, the lasting good from a health standpoint should be presented in connection with needed sewage treatment works. Bond issues should be interpreted to the voters on a per capita cost basis rather than as a lump sum which might be staggering.

F. M. Veatch of Kansas City, Mo., in a paper on **"Operating Data of Tulsa Sewage Treatment Plants"** stated that two similar plants treating about the same type of sewage had produced results which do not check very closely, although each plant is doing all that is intended in the matter of treatment, emphasizing the fact that it is difficult to compare treatment processes at different locations. Due to the fact that existing sprinkling filter beds had been rehabilitated by the installation of a new distribution system without increasing the area, they were loaded at the rate of 523 and 318 lb. of B. O. D./acre foot/day respectively at the two plants while 200 lb./acre foot/day is customary. Despite this fact the effluents have been stable and of good quality. At the two plants there has been a great variation in strength and quantity of the sewage, the variation being as high as 1000 per cent. In no other chemical process is there as great a variation in the raw product and plant operators should be glad that they are able to accomplish as much as they do in sewage treatment. Moving pictures of the plants were shown.

W. D. Hatfield of Decatur, Ill., in a luncheon address discussed **"Methods of Financing Sewage Treatment Projects."** He outlined the method of building plants under the provisions of the Sanitary District Law of Illinois. He traced the evolution of a treatment project required because of law suits due to contamination of a stream. It is more judicious to put money into concrete for treatment purposes than to pay it out for damage suits. The importance of providing taxes to definitely go into a fund for treatment plant operation and additions was stressed. The Sanitary District Law allows for the formation of a district which may issue bonds in excess of the allowable municipal indebtedness, provides a 3-mill tax for operation and replacements, and eliminates the disastrous effect of changes brought about by political turn-overs.

In a round table discussion **Dr. Hatfield** outlined the various methods of sewage treatment, and brought out the importance of careful operation of plants. Reasons for the importance of careful operation are (1) To give the city its money's worth for the investment; (2) Satisfy the requirements of the State Board of Health; (3) To accumulate operating data which may be used for (a) protection of the municipality in cases of damage suits, and (b) the guidance of designing engineer in planning future additions. A plea was made to give State Sanitary Engineers more power in enforcing strict regulations in regard to sewage treatment. Every plant, no matter how small, should keep operating records, the extent of the records depending upon the size of the installation. At Decatur, Ill., a record is kept of every mechanism, not entirely for the purpose of useful data, but to serve the purpose of requiring the periodic inspection of all mechanisms by the operators.

H. E. Schlenz of the Pacific Flush-Tank Company in a paper on **"Some Interesting Features of Sludge Drying"** brought out the importance of balancing the depth to which sludge is drawn on sludge drying beds with the moisture content of the sludge. For ordinary sludges a depth of from 8 to 12 in. is most desirable with a preference towards the shallower depth. That entails more frequent removals, but takes advantage of a greatly accelerated drying. The importance of second stage of drying, or evaporation, as contrasted to the draining process was shown. The resistance to the evaporation or release of the

*Mr. Delzell, who formerly served in public utility operation, has made an extensive study of the means and legal aspects of financing sewerage construction, maintenance and operation.

A Group of Members and Guests of Oklahoma Conference Entertained by the Midwest Meter Co., at Tulsa, Okla.

non-draining liquor is due to the water-binding properties of the sludge. This is largely broken down during digestion, and may be further broken down by the addition of chemicals to the sludge when it is drawn. The presence of water-binding properties of sludge may be readily shown by comparing frozen and unfrozen samples of a sludge, the freezing causing a change in the colloidal structure thus releasing more moisture by draining. It is important that there be good cracking of the sludge to present a large amount of surface for evaporation. **H. J. Darcey,** State Sanitary Engineer, stated that sludge drawn to the depth of about 6 in. gave about the most economical use of sludge drying beds.

V. V. Long of Oklahoma City in a discussion of **"Sewage Disposal for Elk City, Okla.,"** reported on a study to determine the best type of treatment suited for the handling of the creamery wastes encountered at this town. A separate sludge digestion process, with the treatment of the effluent by sprinkling filters was finally decided upon. An existing plant will be utilized by providing additions to the present treatment process.

E. R. Stapley, Associate Professor of Civil Engineering at Oklahoma A. and M. College, in a paper on the **"Measurement of Flow at Sewage Treatment Plants"** likened the keeping of records in modern treatment plants to the keeping of books in a large business establishment. The investment represented in sewage treatment works makes it necessary that close operating records be kept. Flow measuring devices can easily be installed in the plants not equipped with them, and will provide a very valuable record.

H. J. Darcey, State Sanitary Engineer, gave a progress report of the **"Experimental Studies at Oklahoma City"** carried out for the purpose of determining the best type of treatment to be used in connection with their present Imhoff tanks which were designed for 2 M. G. D. and have been loaded as high as 7.3 M. G. D. Damage suits of a total of $1,000,000 are pending and one judgment has been awarded. Very satisfactory results have been obtained by the use of a ferric chloride treatment of the raw sewage before settling in the Imhoff tanks, the ferric chloride being formed by passing chlorine over scrap iron. About 65 lbs. of chlorine per M. G. of sewage is used.

L. H. Scott, Filtration Engineer of the Water Department, who is conducting the tests, stated that at Perry, Okla., this treatment with ferric chloride had been tried on an Imhoff tank, trickling filter plant with the same satisfactory results. Sludge, drawn once a week, dried very rapidly, as a result of the chemical treatment. It was stated that it appeared that such treatment before sedimentation would allow very high rates of dosage on sprinkling filters.

E. Harper, plant operator at Elk City, Okla., stated that they were trying ferric chloride treatment on a sewage containing milk wastes but had not come to any conclusions as yet.

Dr. Harrison Hale, Professor of Chemistry, Univ. of Arkansas, Fayetteville, Ark., in a paper entitled **"Flourine in Water and Mottled Enameled Teeth"** pictured the deplorable condition of teeth caused by the presence of flourine in drinking waters. The presence of flourides in drinking waters is difficult to trace and therefore it was difficult to find it to be the cause of the deterioration of teeth in certain endemic areas where so-called mottled enamel teeth were found. Flourine seems to have no effect upon teeth after they are formed, but attack them during the formative stage of the permanent teeth. A number of endemic areas are found west of the Appalachian Mountains, best known of which are Bauxite, Arkansas and Chetopa, Kansas; where deep well supplies are used. It has been determined that the presence of flourine in excess of 2 p.p.m. will cause deterioration of teeth.

Dr. J. S. Walker of Chetopa, Kan., pictured very clearly the serious consequences of flourides in water.

W. R. Spencer, Professor of Civil Engineering, University of Arkansas, Fayetteville, outlined methods of making **"Waste Water Surveys"** and showed the importance of the various ways in which water is wasted. In a survey on a 100 per cent metered system it was found that 18 per cent of the gross receipts were not collected due to the inaccuracies

in the meters. It appeared that regular meter inspection and replacement was the most important item in waste prevention.

M. Fistein of the Simplex Meter Company in a paper, **"Meters for Water Filtration Plants,"** brought out the importance of controlling the rate of flow through a filter bed, stating that the effectiveness of the bed depended upon the nature of the mat formed upon the surface of the bed. A varying rate will tend to cause water to break through this mat in places, resulting in improper treatment.

L. E. Roberts of the Standard Filter Company of Tulsa, Okla., told of the **"Maintenance of Filter Plant Gauges, Meters and Rate Controllers,"** stating that it was found by the proper use of gauges that it was possible to save, in wash water alone, a total of 2,184,000 gal. in a year for a 1 M. G. plant. Each plant should have provisions for periodic checking of all gauges and controllers to obtain the best efficiency from them.

L. K. Cecil of the International Filter Company in a discussion of the **"Industrial Uses of City Water Supplies,"** pointed out that there has been too much weight given by plant operators to the producing of drinking water, without considering the industries needs in the way of water. Many times industries are forced to find their own supply to eliminate objectional substances in the water, while some minor change in the process at the municipal plant would make it possible for the industry to use the city water. Industries do not require a water very far different from that desired by domestic users.

J. T. Grimsley of the State Health Department gave an interesting paper on **"Zeolite Water Softening in Oklahoma"** in which he stated that it was necessary to consider the type of water to know whether the Zeolite process would be more advantageous than the lime-soda process. The operating cost of zeolite softeners appears to be lower for removing permanent hardness but is greater for removal of temporary hardness than is true of the lime-soda process. **C. Bullen,** Superintendent of Filtration at Stillwater, Okla., in answer to a question on the effect of residual chlorine in water treated in Zeolite softeners, stated that he had not encountered any difficulty in this regard. **L. K. Cecil** stated that the amount of wash water required with zeolite softeners depended upon the hardness of the water, and might run as high as 50 per cent of the water used. **F. R. Hassler** remarked that when a supply to be softened comes from a number of sources, it is necessary to consider the chemical analysis of each source before selecting the type of softening.

Dr. O. M. Smith, Professor of Chemistry, Oklahoma A. and M. College discussed the question of **"Salt for Zeolite Softeners,"** outlining the process of obtaining salt from the salt brines obtained in the oil field district, and utilizing the waste heat from oil refineries for evaporating the brine. **C. Bullen** stated that it did not take as much salt produced by evaporation for regenerating his softener, as was required of ground rock salt. **J. T. Grimsley** stated that salts high in calcium chloride caused difficulty in connection with the regeneration of softeners.

H. N. Olds, Sanitary Engineer, U. S. Public Health Service, New Orleans, in a paper on **"Water Supply Problems During Floods and Major Disasters,"** described methods used for protecting and correcting water supplies during times of major disasters. Chlorine plays a large part in disinfecting water supplies in stricken areas. A careful survey of all wells and private supplies should be made followed by heavy doses of hypochlorite. Wells should be placarded to show whether the water is safe or not. The drought of the past few years has brought up many problems in the obtaining water from polluted streams. The need of conservation and the locating of greater water facilities has been demonstrated during such droughts.

During a luncheon meeting, **President (Dr.) H. G. Bennett** of the Oklahoma A. and M. College, addressed the group, stating that at this time of retrenchment in public expenditures it is necessary to put before the public the human need of public improvements rather than of the cost.

M. R. Jackson, of the Chase Brass & Copper Company, Waterbury, Conn., gave an interesting **"Lecture and Demonstration of Copper Water Tube and Fittings,"** bringing out the necessity of flexibility in the connections between the service pipe and the building.

M. B. Cunningham of the Water Department at Oklahoma City, stated that they had found the use of dry ice very helpful in replacing services without shutting off the water in the main. The portion frozen remains tight for about 15 minutes which is sufficient for making the connection. The dry ice is bought a pound at a time and costs 10 ct. per pound.

"Sanitary Well Construction" was discussed in a paper prepared by **A. J. Fiedler,** Engineer, U. S. Geographical Survey, Washington, D. C., and read by F. R. Hassler. Location of wells in relation to sources of contamination is very important especially where there is the possibility of faults in the rock structure through which the well is drilled. All wells should be thoroughly sterilized after being constructed.

E. H. Skinner, Water Superintendent at Okmulgee, Okla., described **"The Results from the Use of Ammonia at the Okmulgee Water Plant"** for controlling tastes and odors following chemical treatment. **F. R. Hassler** stated that a creamery using water treated by chloramine found that a taste was imparted to their cottage cheese. It appears that chloramines are best for the treatment of dead algae growths producing tastes and odors, but do not seem to have any effect upon the tastes produced by (dead) woods.

R. King of the Oklahoma A. and M. College described some studies made on the **"Effect of Salt Concentration Upon Chloramine Disinfection"** which were carried out following some observations on the varying effectiveness of the chloramine treatment at Stillwater. It was found in controlled tests with B. coli samples containing varying concentrations of salt, that for normal concentrations of salt which might be encountered, there does not seem to be any appreciable effect upon the amount of chloromine required. A paper by **A. E. Howe** and **L. H. Brandt** of the National Ammonia Company, Philadelphia, Penn., read by **R. King** and stated that the point of application of ammonia varies with the different types of waters encountered. The chemical inertness of the chloramine prevents it being expended in the oxidizing of organic matter. Its ultimate effect is the same as chlorine although it is slightly delayed.

J. P. Harris of the Industrial Chemical Sale Company of Chicago addressed the group on the subject **"Powdered Activated Carbon, What It Is, and Some Applications,"** in which he said that the marked absorbing power of activated carbon was due to its

great surface area. That had been stated to be 20,000 square yards per cubic inch of powdered activated material. The point of application of the activated carbon seems to be unimportant as long as sufficient mixing is allowed. It tends to aid coagulation by absorbing colloidal particles and enzymes of bacterial bodies. **Dr. O. M. Smith** stated that there were certain types of charcoals which were sensitive for certain tastes and odors. **F. R. Hassler** stated that in one instance chloro-ammonia treatment was used on a raw water, with alum and powdered activated carbon treatment following. The activated carbon had not removed the chlorine as was the case without ammonia treatment. Under some circumstances less chlorine had been required to give the same residual if activated carbon was employed.

F. R. Hassler, Engineer with State Board of Health, in a paper on **"The Cycle of Biological Growths in Polluted Streams"** pointed out that the extent of pollution may be measured by the number and type of organisms present. Plankton perform a very important role in the purification of a stream and indicates the past nature of the pollution.

H. G. Freehauf, Superintendent of Utilities, described the **"Construction and Operation of the Miami, Oklahoma, Municipal Pool"** and pointed out that it is important to determine the proper proportion of different depths in the pool to obtain the maximum efficiency from the area utilized. The water is treated with chloromine and does not have any effect upon the bathers.

The **"Organization of Municipal Fishing and Its Relationship to Sanitary Water Supplies"** was presented by **A. D. Aldrich,** Fish Culturist of Tulsa, Okla., in which it was stated that fish played a very important part in the control of growths in reservoirs. It is entirely feasible to make use of even small reservoirs for municipal fishing without any detrimental effects to the water supply from a sanitary standpoint. In a discussion **H. J. Harper,** Agronomist, Oklahoma A. and M. College discussed the relationship of soil conditions to the proper balance of the conditions desired in storage reservoirs. When soil is high in acidity there is a tendency for clays to be held in suspension in the water of the reservoir, while normal flocculation is caused by the concentration of bicarbonate ions. Springs are helpful in supplying the bicarbonate ions.

NEW OFFICERS ELECTED

A. Love of Ardmore, President.

L. Bennett of Holdenville, Vice-President.

Directors

R. Dohe of Tahlequah, **J. Killiam** of Cordell and **L. H. Scott** of Oklahoma City were named as directors.

H. J. Darcey, Chief Engineer of the State Health Department, was re-elected as secretary.

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Montana Section A. W. W. A.

The Seventh Annual Convention of the Montana Section, A. W. W. A., was held in Livingston on April 1 and 2, 1932. There were 65 registered for the meetings and 83 attended the banquet on Saturday evening.

The high light of the convention was the presence of Geo. W. Pracy, Superintendent of the San Francisco Water Department, and nominee for president of the parent association. His attendance and speaking added very materially to the success of the occasion.

What was anticipated as a severe setback to the convention was the auto accident on the eve of meeting, in which the host, J. R. Cortese, was severely injured. However, due to his tremendous energy in making arrangements to the last minute detail, the affair proceeded with unusual smoothness. The latest word from him is that recovery may be expected in about two weeks.

H. M. Johnson, Chairman, presided with his characteristic energy and kept the sessions lively. The principal topics for papers and discussions were:

"The 51st Annual Convention held at Pittsburgh in 1931,"—a report by Wade Plummer, Superintendent of the Butte Water Company.

"The Design and Operation of the Water and Sewage Treatment Plants for Boulder City," by Earl W. Kelley of the Dorr Company.

"The Livingston Water System and Filtration Plant," by J. R. Cortese, Superintendent (read).

"Gas as a Utility," by William H. Barton, Manager, Gas Division, Montana Power Co.

"Round Table Discussion," led by Jos. M. Schmit of Lewistown.

"The Use of Ammonia in the Treatment of Water," by J. W. Forbes of the Montana State Board of Health staff. (In the absence of Mr. Brandis of Chinook.)

"Covering the City Reservoir at Columbus," by I. E. McClure, Superintendent, Columbus Water Department.

"Advantages and Disadvantages of Company Ownership of Connections from Water Mains to Property Lines," by W. S. Vrooman, Manager, Commonwealth Public Service Company, Deer Lodge.

The participation in the Saturday morning Round Table in charge of J. M. Schmit, City Engineer, Lewiston, showed the keen interest taken by the delegates and visitors assembled.

Dr. Cogswell, Secretary of the State Board of Health, attended. He urged the Livingston City Water Commission to equip their very fine filtration plant in that city with a full laboratory as a fitting testimonial to the efficiency and hard work of Mr. Cortese, the Superintendent. He also urged the establishment of local laboratories in all water works plants, especially where filtration is practiced in the state.

Prof. W. M. Cobleigh, Dean of Engineering, at the State College, Bozeman, lent his support and spoke on behalf of the School for Water Works Operators, which he had conducted, in cooperation with the State Board of Health, two days previous to the annual convention.

The association went on record as favoring the sewer rental method of raising revnue to defray expenses of operating sewage treatment plants. It also favors legislation for the purpose of placing the water departments of all cities of the first class and authorizing all others to place by ordinance the water departments under Civil Service regulations.

Among other things, the Section authorized the incoming chairman to appoint a committee to study the part it may play in the work of fostering water conservation and utilization as outlined by Mr. James, State Engineer.

Wm. Brooks, State Fire Marshal, reported that practically all fire hose, nozzles and hydrant connections in Montana were now of standard size and thanked the members of the organization for their assistance in the detailed work involved in making the necessary changes.

A. L. Bavone, Secretary, North Dakota Water and Sewage Conference, attended the meetings.

Passing suitable resolutions, the Section adjourned after selecting Havre for the 1933 (8th) Convention (date to be fixed later) and electing Wade Plummer, Superintendent, Butte Water Department, Chairman; and Fred Quinnell, Superintendent, Roundup Water Department, Vice-Chairman.

WHAT VALUE ARE WATER WORKS CONVENTIONS TO OPERATORS?

Jane Rider

By JANE H. RIDER, C. E.

Director,
Arizona State Laboratory, Tucson

The author of this article is a graduate civil engineer and enjoys the distinction of being the second woman to be elected to membership in the American Society of Civil Engineers. She is president of the Alumni Association of the University of Arizona. Her alma-mater bestowed upon her the professional degree of Civil Engineer in 1930. With the exception of two years of war service overseas, she has served the State of Arizona continuously since 1913. She is a member of the executive committee of the Conference of State Sanitary Engineers and serves as secretary of the Arizona Public Health Association.—Editor.

MR. Average Citizen is apt to think of a gathering of water works men as just another convention, a place where the boys can forget the daily conventions of home life and have a riotous time for a few days. True the technical sessions during the day are usually leavened by good fellowship after sunset.

Long years ago I timidly asked permission to leave the state to attend a meeting of the American Water Works Association. Scornfully I was told conventions were of no benefit to men and somewhat less than that to women. I muttered something about scientific papers and information our department needed. The only answer was that any papers of value would be printed and could be read in my office with more intelligent understanding than if I listened to them in a crowded hall. All of which is correct, except that it does not take into consideration the personal element of such meetings. Using my annual leave and a sketchy bank balance, I went to this meeting on my own, and that speculation in the form of travel expense has paid greater dividends, than have come from more highly recommended investments. A few acquaintances made at that time are now friends of long standing, who have more than once helped us in solving some knotty problems.

Now the question of listening to technical papers, some presented with snap and precision, others droned through. The man in the audience may miss a few of the fine points and have only a vague idea of the masses of figures presented; still he will get enough of the author's meaning to either agree or disagree with him. Disagreeing with the speaker breeds the best sort of extra session discussion. The talk up in someone's room starts out with how wrong that fellow from Jonesboro was in his figures on water consumption and then jumps to this and that until you have told all your pet experiences and learned from the fellow up state just the things you wanted to know to make the job run more smoothly or more economically.

Recently *Engineering News Record* carried an editorial comment on the meeting to commemorate the fiftieth anniversary of the founding of the New England Water Works Association which was headed: "To Exchange Ideas." Certainly that is the essence of all meetings of water works men. How much progress do you think would be made in the smaller towns if the plant operators did not know any of the other men in their profession? How many of them would read technical publications for the information they contained if there was not some chance of talking over these new facts with fellow workers? And again, articles are frequently read because the reader has met the author at some convention or meeting.

The scientific papers that one hears are important creators of ideas. To read them in cold print is helpful, but how vastly more valuable to be able to discuss them or hear them discussed while the subject is still warm; to be able to tell your experience with that phase of operation, or to ask the writer a question that has been bothering you for months. So, ideas are exchanged and progress made; old problems have been solved, new methods are being devised. A glance over the convention programs of a few years ago will indicate the advance. Then we listened to papers on "What is the Legitimate Use of Water" and talked excitedly of the application of colloid chemistry to filter effluents; now there are activated carbons and chloramines, corrosion control—something new all the time.

There are benefits from hearing and discussing papers; probably preparing them is of even more value to the water works operator. It is no secret that a man is more concerned with his plant if he feels that the methods he develops are of interest to some one else. How much more carefully and willingly records are kept if they are to be used as the basis of study, and the results are to be read with the operator's conclusion at a meeting somewhere. Such efforts engender an honorable professional esteem, a pride in good workmanship. There is something very stimulating in seeing one's name and thoughts in print, and how can most of us achieve this unless we take an active part in our professional societies. To work, to record, to publish conclusions, is infinitely better than just to work twelve months for so much per annum.

Short schools of instruction for operators are held in connection with some of the water works conventions. These give concentrated courses in bacteriological and chemical methods enabling a man to make his own control tests and to interpret results; illustrate new developments of water purification, better operating proceedures, and short cuts that have been devised. A bacteriological report will certainly have more meaning for the man who has actually handled test tubes and looked a B. coli square in the face. They will not be classed with the pumper in an isolated mining camp who, after being advised that B. coli found in the water sample indicated sewage contamination of fecal origin, wrote: "You all are sure a bum lot of guessers; the nearest sewer is 30 miles away."

The man attending a section or a national meeting gets to know his fellow workers, establishes better relations with state control officials and the research staffs of the Universities, meets consulting engineers and sales representatives of the manufacturers of water works equipment and can learn much by inspecting the exhibit of equipment. Such gatherings are the leaven of toil; they lift noses off the grind stone of daily routine, and allow an operator to get a clearer perspective of his job.

Get a group of water works men together in any town, at any one time, and amid all the play and noisy laughter there will be an undercurrent of shop talk, a current strong enough to smooth off the troublesome sharp edges and build up new deltas of enthusiasm for the job.

Disasters arrive without notice or invitation. If a water works is crippled or destroyed, a telephone call to fellow superintendents will start emergency equipment towards the damaged plant; operating personnel will be loaned to help in the rehabilitation; and with this cooperation the dangers of water-borne infections are checked. Such aid can be requested and furnished with far greater efficiency when water works men have gone visiting about the state and have an idea of the type of supplies the neighboring plants can furnish.

To exchange ideas, to meet fellow workers, are the purposes of water works conventions. Serious talk in regular sessions, pleasant and friendly contact at all times, a chance to play, to renew enthusiasm, and to develop a pride of profession. For these do you gather together, agreeing and disagreeing, and if it profiteth you not, the blame is not entirely with the program committee.

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HYDRANTS BROKEN BY AUTOMOBILES AT NEW BEDFORD, MASS.—The Water Board of New Bedford, Mass., in its annual report for the year ending Nov. 30, 1931, states that 19 hydrants were broken off in that year by skidding or carelessly driven automobiles. The cost of repairing them was $966.18, of which $251.88 was collected from the owners or their insurance companies. The above amount does not include water wasted through the broken hydrants.

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COST OF WATER PUMPAGE, OMAHA, NEB., 1924-1931.—The January Public Service Bulletin of the Metropolitan Utilities, District of Omaha, Neb., gives the following comparison between costs of water pumpage in 1924 and in 1931:

	1924.	1931.	Difference.
Pumpage, million gallons....	9,655	10,254	+599 million gals.
Gallons pumped at Florence per pound of coal.....	170	203	+33 gallons
Gallons pumped at Florence per dollar of coal.....	73,156	124,174	+51,018 gals.
Coal and equivalent power consumed at Florence, tons	28,373	25,227	—3,146 tons
Cost of coal and power at Florence	$131,978	$82,577	—$49,401.00
Total cost of all pumpage....	$353,011	$317,904	—$35,107.00
Cost of coagulants, chlorine, etc.	$21,696	$15,470	—$ 6,226.00

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AN AID IN HANDLING VALVES AND FITTINGS.—At Bucyrus, O., during the construction of an addition to the filter plant hangers of reinforcing iron were built into the ceiling of the pipe gallery. These have proved very useful in handling valves and making some changes in the piping. It is an idea which could be incorporated in any new plant at no expense.

Double Tragedy at Lima, O., Sewerage Treatment Plant

Earl I. Roberts of the firm of H. P. Jones & Co., Consulting Engineers, Toledo, O., sacrificed his life May 4 in an attempt to rescue Earnest Aronholt, an operator from a gas filled chamber at the new sewage treatment plant of Lima, O.

The treatment plant, which has been in operation since February was designed by H. P. Jones & Co., and Mr. Roberts had supervised its construction and initial operation.

Aronholt was descending a ladder into a test chamber adjacent to a digestor tank when he was overcome by gases which had seeped into the chamber from the sewage tank. He fell 15 ft., suffering a fractured skull and wrist. His fall was witnessed by another employe, who called Roberts for aid. Roberts, who was making a periodic inspection of the new plant, ran several hundred yards and descended into the chamber to rescue Aronholt, but was overcome immediately by the gas. Both men were brought to the surface by city firemen and power company employes. Aronholt was removed to the City hospital. Firemen worked with a respirator for more than an hour in a futile effort to revive Roberts. Physicians said Roberts inhaled greater quantities of the fatal gas than Aronholt because of the fact that he was out of breath from running when he entered the lethal chamber. Gas masks were worn by the workers who removed the unconscious men from the testing chamber.

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Spring Meeting New York State Sewage Works Association

The spring meeting of the New York State Sewage Works Association will be held June 10 and 11 at the Hotel Statler, Buffalo, N. Y. Registration and inspection of manufacturers' exhibits from 9 A. M. to noon on Friday, June 10, will be followed by luncheon.

Friday afternoon will be devoted to a short business session and presentation of technical papers. Friday evening we will have the usual banquet and special entertainment.

A round table discussion with ample time to hear from all will occupy Saturday morning followed by a brief description of the sewage treatment plants to be visited, while Saturday afternoon will be devoted to an inspection trip covering five sewage treatment plants in the vicinity of Buffalo. For those who wish, arrangements can be made to extend the trip to the Dunkirk plant 40 miles south of Buffalo.

The Ladies' Committee has arranged splendidly for the entertainment of our ladies. The ladies will leave the Hotel Statler at 12:00 noon on Friday for luncheon at the Buffalo Consistory. A trip to Niagara Falls is planned for Friday afternoon, returning to Buffalo in ample time to dress and join the men at the evening banquet and entertainment. Saturday the committee has made the rash promise to provide free auto transportation for the ladies for any place to which they desire to go.

More than 20 manufacturers have already engaged space for exhibits in parlors adjacent to the meeting room on the mezzanine floor.

Sixth Annual Conference Maryland-Delaware Water and Sewerage Association

Ninety-two people attended the 6th Annual Conference of the Maryland-Delaware Water and Sewerage Association, held in Cumberland, Md., April 12 and 13. While the attendance was somewhat below normal, the meeting was the best ever held by the Association.

Harry R. Hall, President of the Association, presided at the first day's sessions, while R. C. Beckett, the incoming President, presided over the second day's sessions. Abel Wolman conducted the discussion of the question box topics.

The first paper was presented by **Professor Lewis** V. Carpenter of the West Virginia University, on **"Elementary Sewage Disposal."** Professor Carpenter traced the methods of sewage disposal from the time of Moses to the present day. Brief descriptions were given of the various units of treatment plants, their functions and uses.

George L. Hall, Division Engineer of the Maryland State Department of Health, in his discussion of this paper, stated that there were 38 sewage treatment plants in Maryland of which 13 were institutional plants. The need for competent operators was stressed.

"Admission of Industrial Wastes Into Sewerage Systems" was the topic covered by **H. M. Freeburn,** District Engineer, Pennsylvania Department of Health. Industrial wastes were discussed as being divided into four classes: (1) those that can be admitted to the sewerage system without preliminary treatment; (2) those that can be admitted after flow adjustment without any preliminary treatment; (3) those that can be admitted after they have been given preliminary treatment, and (4) those that should be excluded from the system. The speaker concluded his paper by saying "If you are right, fair, and just, and have properly presented your case showing the need for industrial waste treatment to responsible industrial plant executives, there will be little trouble.

In the discussion of this paper **J. B. Gordon,** Sanitary Engineer, Washington, D. C., reported on the disintegration of a concrete interceptor in Washington due to the entrance of trade waste. The waste from a yeast factory was harmless, but in combination with the bacteria in the domestic sewage it had caused the sulphate content to be broken down and hydrogen sulphide to be produced. Arrangements have been made to chlorinate the domestic sewage at a point prior to the entrance of the waste into the interceptor and the elimination of the bacteria was expected to prevent sulphate break down.

A symposium describing the method of controlling the pollution of streams in their respective states was given by R. C. Beckett, W. L. Stevenson, E. S. Tisdale and Abel Wolman, State Sanitary Engineers of Delaware, Pennsylvania, West Virginia and Maryland, respectively.

"The Proper Relation Between the Medical Health Officer and the Water Department" was presented by **H. H. Weiss,** Health Officer of Cumberland, Md. **J. J. Shank,** Director of the Wayne Laboratories, Waynesboro, Pa., next presented a paper on **"The Influence of Soils, Rocks and Minerals Upon the Potability of Water."** A rare exhibit of minerals, rocks, etc., gathered from all parts of the world was presented with the paper.

"The Effect of Water Waste Upon Stored Supplies with Particular Reference to Ashland, Pa., and Cumberland, Md." **H. E. Beckwith,** Pitometer Company, using the figures obtained in the survey of the distribution system of these two cities and presenting them together with charts showing the rate of depletion of the stored water during the past two years of drought, stated that had all leaks been stopped the supplies would have held out several months longer. It was indicated that as far as the duration of supply was concerned a 40 per cent reduction in consumption would have been equivalent to an increase of 100 per cent in the amount of storage, in the case of Ashland and a 22 per cent reduction in consumption at Cumberland would have been equivalent to an increase of 43 per cent in storage. The fact was brought out that while a plant may easily carry the load of preventable waste during normal years, this waste works with a decided leverage in periods of drought and may then prove to be solely responsible for the failure of the supply.

Mr. J. Wrench, Sales Manager of the Industrial Chemical Sales Company, Inc., read a paper prepared by F. E. Stuart, Research Engineer of the same company, on **"Development of Powdered Activated Carbon in Water Plants During Recent Months."** The application of powdered activated carbon along with the coagulant has resulted in reductions in the amount of coagulant necessary and in the stabilization of the sludge in the basins permitting longer periods between cleaning of the basins. Also when the basins are cleaned no offensive odors are given off. Other developments are: that residual alumina is reduced when powdered activated carbon is used in the coagulation process; absorption of organic matter by the carbon particles in suspension act as a "balance wheel" in controlling fluctuations in chlorine demand; it will not remove a chlorine residual or resulting compounds effectively; its application ahead of prechlorination dosage has increased the chlorine residual in several instances.

Discussing the paper, **C. A. Hechmer** of the Washington Suburban Sanitary District, stated that experiments with the application of activated carbon at the inlet and effluent of the coagulating basin had indicated the former location as more desirable. It was found that coagulation was aided and a sufficient amount of the carbon found its way through the basin to the filters. Elimination of odors in removing the sludge from the basins was also noted.

H. H. Allen of the J. E. Greiner Company, Consulting Engineers, discussed the building of the new Thomas W. Koon dam for the Cumberland water supply. A laboratory was set up on the job and very accurate figures on the concrete mix, etc., were obtained.

At the business meeting of the Association, the following officers were elected:

President—R. C. Beckett, Dover, Del.

1st Vice-President—B. E. Beavin, Annapolis, Md.

2nd Vice-Presdient—J. S. Strohmeyer, Baltimore, Md.

Secretary—A. W. Blohm, Baltimore, Md.

Treasurer—E. S. Hopkins, Baltimore, Md.

Executive Committee—S. N. Van Trump, Wilmington, Del.

EDITORIALS

Water Works vs. Sewerage

IN an editorial comment in the March issue of WATER WORKS AND SEWERAGE appeared an extract from a report of the F. W. Dodge Corporation. To the apparent amazement of many readers, it was reported that in American cities east of the Rocky Mountains practically two dollars had been expended for construction of sewerage and sewage treatment works as against one dollar expended for construction of water works and water purification plants. That was for the year past—1931.

An examination of budgets set up for the year 1932 by 45 important American cities again reveals a greater allowance for sewerage and sewage treatment than for water works and water purification, the totals being $36,521,000 for the former and $33,975,000 for the latter. Excluding from the totals the large appropriation of practically $13,000,000 set up by Los Angeles, for water works, would bring the figures to $1.66 to be expended in 1932 for sewers and disposal as against $1.00 for water works as the average for these 45 cities.

American municipalities are definitely pollution conscious and are leading the way in the matter of correcting waterways pollution evils. It is decidedly industry's turn to take similar steps with its wastes that, volume for volume, as a rule, are many times more damaging to streams than is municipal sewage.

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How Big Is a Microbe?

ONE of the most difficult conceptions of the average student in chemistry is to picture in his mind the size of molecules, atoms, and electrons—not to mention the recently announced neutron. Even the conception of the size of a particle of material bearing the label colloid is difficult. The student of biology has the advantage when it comes to a conception of the size of a microbe because bacteria are at least visible under the microscope.

Learning by comparison is the simplest and most direct process and we are indebted to Dr. Stanhope Bayne-Jones for answering by picturization the question "How big is a microbe?" In his recent book *Man and Microbes* he explains—"Suppose 25,000 soldiers of an infantry division were formed up in a single rank with an allowance of 18 in. for each man. This line would be 7.5 miles long. Suppose, next, that some omnipotent officer from headquarters should give the command "Dwindle!" and at the word of command, each soldier would shrink to the width of an average bacterium (1 micron) and close up on his neighbor. Their line would then be about 1 in. long. Twenty-five thousand typhoid germs could lie comfortably side by side in an inch." Dr. Bayne-Jones further pictures the size of a microbe by saying that, "A microbe with a volume of 1 cubic micron and a specific gravity of 1.2 would weigh 0.0000000012 milligram." It would therefore take about 833,000,000,000 microbes of this size to weigh 1 gram and to weigh one ounce would require about 23,573,900,000,000 typhoid germs.

It is doubtful, even with such a picturization, that the average man will grasp a true conception of the insignificant size of disease producing germs. Would it not be natural, however, for him to wonder how much longer wars will be fought with cumbersome implements and ammunition when small cans of microbes and airplanes to scatter these might be all that is required to put a belligerent nation "on its back." Poisonous gases appeared as offensive weapons in Chemical Warfare for the first time in the World War. Who knows but that the next war may find disease germs used in Biological Warfare.

L. H. Enslow

Molten Tides as the Cause of Ocean Tides

BY studying both the transverse and the longitudinal waves caused by earthquakes it has been determined that the earth's core is fluid. The diameter of this molten core is about 45 per cent of the diameter of the earth. It follows that the moon and sun must cause tides in the molten core. Since the solid crust is only about 25 miles thick, and floats upon a pasty mass that intervenes between it and the fluid core, the crust can not appreciably resist the tidal distortion of the core. In short the spheroidal shape imparted to the fluid core by the gravitative force of moon and sun must be imparted also to the crust. In consequence the ocean constantly tends to flow in tidal currents toward the regions where the crust is most depressed by the tidal deformation of the molten core.

This being the case we should find the highest ocean tides about 90 degrees of longitude away from the highest molten tides, or about 6.2 hrs. after conjunction or opposition of sun and moon. Most of the ports on the islands of the Pacific Ocean show quite a close approximation to this relation. The Pacific is a deep ocean comparatively unobstructed by submerged plateaus or ridges, hence its tidal currents are neither retarded greatly by friction nor ponded except near the coasts of continents.

Chains of islands, like those that almost enclose the China Sea, act like dams, and the submerged ridges that connect such islands act like submerged weirs. Consequently ponding of ocean water occurs when the tidal currents flow into such basins, and therefore it modifies the times at which high and low tides occur.

The prevalent Laplace theory of tidal vibration of the ocean is based on the assumption of an earth solid, or nearly solid, to the center. It has served to explain why a "lag" in tides may occur, for it was invented to do so; but it has never explained either the extent of the "lag" nor any phenomenon that it was not originally designed to explain. Hence it has never passed beyond the stage of plausibility. Now that the earth's core is known to be fluid the Laplace theory ceases to be even plausible. Yet it will probably be 10 or 15 years before that theory of tides is dropped from text books.

Not many scientists realize that a theory can not be said to be established until probability calculations show that its agreement with facts is such as to be highly improbable as a matter of accident. Failing to apply such a test they are prone to accept as true any theory that is plausible provided that it is sponsored by a man of established reputation in the field to which the theory relates.

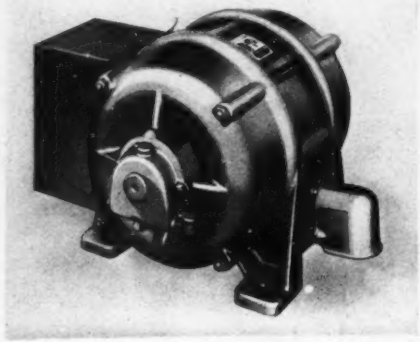
H. P. Gillette

NEW EQUIPMENT AND MATERIALS

The Noel Polyphase Capacitor Motor

Mr. C. W. Noel, Consulting Engineer of The Ideal Electric & Mfg. Co., Mansfield, O., has invented a unique method of applying capacitors (condensers) to polyphase induction motors.

Capacitors are usually applied to polyphase induction motors by connecting them across the motor terminals. This



Noel Polyphase Capacitor Motor

produces a high power factor in the power line but does not affect the motor characteristics or the power factor in the motor proper. The scheme used in Mr. Noel's invention causes the condenser reactive current to flow through the windings of the motor thereby producing a high power factor within the motor.

This scheme is stated to give the Noel polyphase capacitor motor surprisingly improved starting and running characteristics. The outstanding feature claimed is that it operates at practically unity (100%) power factor at all loads, whereas the ordinary induction motor has a lagging power factor around 70-80% and down to 10-20% on light loads. This invention is thus an important improvement because high power factor is a most desirable characteristic.

Another amazing feature is that the Noel polyphase capacitor motor is made in a design giving 80% power factor leading at full load and leading power factors up to 15% (leading) at no load. This gives an extremely efficient device for power factor correction. One of these motors will correct the power factor of two ordinary induction motors of similar size so that the total power factor is near 100%. This means that only one of every three motors in a plant need be of this type to give a plant power factor of unity (100%) which is the most efficient point of operation. This is an important achievement.

For economical power factor correction, the Noel polyphase capacitor motor cannot be surpassed. Several installations have already been made where the total cost of this motor and its capacitor was less than the cost of condensers alone to give the same amount of power factor correction.

The Noel polyphase capacitor motor has all the advantages of the squirrel cage induction motor—high starting torque, low starting current, indestructible rotor and extremely rugged construction, the simplest of starting equipment, and no brushes, commutator or moving contacts of any sort. In addition, it possesses the following advantages over the ordinary polyphase induction motor: unity or 80% leading power factor, higher starting torque, lower starting current, increased efficiency, and less slip with a resulting higher full load speed.

The capacitors used are the oil filled, oil impregnated, hermetically sealed type with individually fused sections. They are assembled in steel cases with conduit connections for mounting on the wall or any convenient location.

The Noel polyphase capacitor motor is also made as a slip ring variable speed induction motor in all sizes and speeds. This invention is particularly advantageous in a variable speed motor as this motor will retain its high power factor at very low speeds, even to 50% of standard rated speed.

This new motor is built in various types to meet all starting torque and in-rush classifications including across-the-line starting in all sizes and speeds up to 200 hp. at 80% leading or unity (100%) power factor. All designs are fully protected under the Noel Patents. Full information on this latest addition to the Ideal line of motors, generators, and control equipment can be had from The Ideal Electric & Mfg. Company, Mansfield, O., or from any of their offices in principal cities.

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Bonna Pipe Now Manufactured in the United States

The Bonna Pipe Company of America, Inc., produces the original steel core, reinforced concrete pressure pipe, which has been most successfully used in Canada, England, France, Belgium, Holland, Spain, Norway, Italy, Denmark, Algiers, Morocco and other countries for the past 39 years.

Bonna pipe is a welded steel pipe lined with centrifugally placed concrete reinforced with bars and spirals. It is coated with very dense concrete placed under air pressure. This coating is also reinforced with longitudinal bars and spirals.

This pipe is absolutely water tight and offers a better coefficient of friction; it

Bonna Pipe

cannot corrode, is free from electrolysis, and offers greater security. The strongest part of a Bonna main is its joint which is immediately and permanently tight.

The Bonna pipe is made to withstand any pressure and in any diameter up to 20 ft.

The best reference for the Bonna Pipe Company is that engineers in twelve different countries have chosen Bonna Pipe for important engineering projects on account of its reliability, strength, flexibility and economy, and that since 1893 2500 miles are in service without any leakage or any maintenance cost.

[redacted]

Financial Center Building, Los Angeles, Calif.

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Warren-Knight Co.'s New Transit-Level

During 1931 the Warren-Knight Co. of Philadelphia developed a new Model combination Instrument known as the Warren-Knight transit-level. This instrument is particularly adapted for the work of the engineer in the Water Works and Sewerage Field, and offers a high degree of accuracy at a moderate price.

This instrument combines the advantages of a wye level with those of a transit, which it resembles in general appearance.

The telescope is mounted in high standards—permitting a range of elevation and depression of 110°—and although the telescope will not plunge like a transit, the special design (patent applied for) permits checking and making adjustments like a wye level.

The lens combination permits taking a sharp reading as close as 4 ft., and is very useful when working at close quarters. For long distance work the brilliance and flatness of field is unexcelled, even by the highest priced precision transits.

One of the most important features of this instrument is the 4 in. circle with vernier reading to one minute. This offers a degree of accuracy in turning or

measuring angles never before available in moderate priced instruments.

The circle is heavily ribbed, and is entirely protected by a heavily reinforced top plate.

The tripod plate is furnished with the standard thread as recommended by U. S. Bureau of Standards. This speeds up the time required for setting up the instrument—decreases wear on the threads and makes the instrument interchangeable on tripod with any transit or level using this thread. The shifting plate permits a movement of 7/8 in. which enables a considerable saving of time in "setting up" over a given point.

The entire construction is such as to assure years of service with a minimum of maintenance and repair costs.

The Warren-Knight transit-level is made either with or without vertical arc and with or without 3 in. compass. The instrument is furnished with solid leg tripod as standard equipment but an extension leg tripod, which is particularly useful in water and sewer trench work, and convenient for carrying in an automobile, is available at small additional charge.

The manufacturer has recently published a new complete illustrated catalog of transits and levels in which the transit-level is completely described. This catalog will be sent on request to Warren-Knight Co., 136 N. 12th St., Philadelphia, Pa.

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R. B. Mowry Advanced By Wallace & Tiernan Co.

R. B. Mowry, of Wallace & Tiernan Company, Newark, N. J., has been advanced to district manager in charge of the company's office at Philadelphia. He

R. B. Mowry

will be in charge of service and sales in the entire states of New Jersey and Delaware and Eastern Pennsylvania. Mr. Mowry was formerly district manager for Virginia, Maryland, New Jersey and Delaware. He was in the service of the Electro Bleaching Gas Company when that company began chlorinator manufacture and ever since the sale of that part of the business to the Wallace & Tiernan Company, Mr. Mowry has been serving the latter. Mr. Mowry has worked his way up from the bottom, has made good, and deserves this promotion. Congratulations "Bob."

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Lukenweld Advances Wilbraham

William S. Wilbraham, who has been in charge of the Estimating and Order Department at Lukenweld, Inc., Coatesville, Pa., since this organization was established in 1929 to manufacture welded parts for machinery and equipment, has been appointed assistant manager of sales, and will work directly with Henry H. Peck, manager of sales for Lukenweld, Inc. Mr. Wilbraham is a graduate in mechanical engineering, Drexel Institute, class of 1925. He was connected with the American Bridge Company as assistant engineer of erection on the Camden end of the Delaware River bridge until March, 1927, when he joined the sales department of Lukens Steel Company, being transferred to the Lukenweld organization when that division was formed.

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Recently Appointed Dealers and Distributors for Permutit

The Permutit Co. of New York City, Manufacturers of domestic water softeners, has recently appointed the following dealers and distributors of their softeners and filters. A large percent of these firms are plumbing and heating contractors: Gilbert Utilities Corp., with 158 dealers, Rochester, N. Y.; Peoria Tent & Awning Co., Peoria, Ill.; Rogers Electric Company, Anderson, Ind.; Evans Electric Company, Bloomington, Ind.; R. B. Hinkle, Logansport, Ind.; Marion Refrigeration Co., Marion, Ind.; E. T. Corcoran, South Bend, Ind.; Central Jersey Cornell Utilities Company, Plainfield, N. J.; Joseph O. Chrystal Co., Summit, N. J.; Heating Units, Ind., Elmira, N. Y.; Morris Hardware Corp., Lockport, N. Y.; Geo. L. Starks & Co., Inc., Saranac Lake, N. Y.; J. R. Sheehan Co., Schenectady, N. Y.; Hunting Supply Corp., Watertown, N. Y.; Geo. N. Clark, Mt. Vernon, Ohio; L. C. Martin, Willoughby, Ohio; R. R. Reeser, Reading, Pa.

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Hayes Represents Pardee in New England

The Pardee Engineering Co., of Long Island City, N. Y., manufacturers of chlorine and ammonia control equipment, announce the appointment of the Hayes Pump & Machinery Co., Boston, Mass., as their exclusive representatives in the New England States. The Hayes organization having been identified in serving the municipal and industrial field for many years, are well equipped to handle the sales and service of the Pardee equipment.

Frank R. Wheeler Joins Worthington

Worthington Pump and Machinery Corporation has appointed Frank R. Wheeler special sales representative with headquarters at their Chicago office. He will cover the mid-west territory, assisting the Worthington organizations in Chicago, St. Paul, Kansas City, St. Louis and Detroit. Mr. Wheeler, who is well known for his work in connection with steam power plants, will devote himself to the sales of Worthington products in that field.

Statement of the Ownership, Management, Circulation, Etc., Required by the Act of Congress of Aug. 24, 1912,

of Water Works and Sewerage, published monthly at Chicago, Ill., for April 1, 1932.

State of Illinois, County of Cook, ss.—Before me, a notary public in and for the state and county aforesaid, personally appeared E. S. Gillette, who, having been duly sworn according to law, deposes and says that he is the business manager of Water Works and Sewerage and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor and business managers are: Publisher, Gillette Publishing Co., 400 W. Madison St., Chicago, Ill.; Editor, L. H. Enslow, 420 Lexington Ave., New York, N. Y.; Managing Editor, C. T. Murray, 400 W. Madison St., Chicago, Ill.; Business Manager, E. S. Gillette, 400 W. Madison St., Chicago, Ill.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)—Gillette Publishing Co., 400 W. Madison St., Chicago, Ill.; H. P. Gillette, 400 W. Madison St., Chicago, Ill.; E. S. Gillette, 400 W. Madison St., Chicago, Ill.; Mrs. R. W. Hume, 303 S. Stone Ave., LaGrange, Ill.; Winifred Gillette, 1125 Oak Grove Ave., San Marino, Calif.; Commonwealth Title Insurance & Trust Co., Chestnut and 12th Sts., Philadelphia, Pa.; Louise Forsythe, 13 East Windermere Terrace, Lansdowne, Pa.; LaVerne Louer Hellyer, Ambassador Hotel, Chicago, Ill.

3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages or other securities are: (If there are none, so state.) —None

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association or corporation has any interest direct or indirect in the said stock, bonds or other securities than as so stated by him.

E. S. GILLETTE,
Business Manager.

Sworn to and subscribed before me this 28th day of March, 1932.

(Seal) KITTIE C. WOULFE,
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(My commission expires Feb. 8, 1934.)

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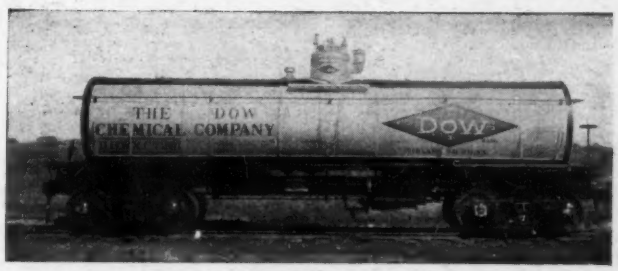

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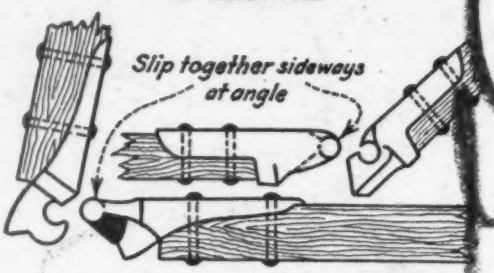

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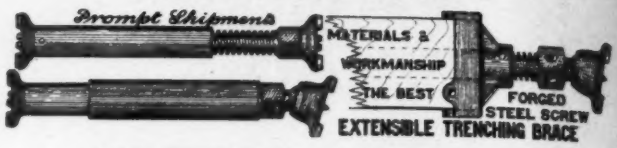

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MARRIED MAN, 36 years old, with 13 years' experience in water purification plant control and operation, also experienced in water meter repairing and testing. Best of references can be furnished. Box 5010, Water Works and Sewerage, 420 Lexington Ave., New York City.

M. A. IN CHEMISTRY from prominent university wants position as chemist or plant operator. Over three years' experience as chemist, chiefly on water and foods. Age 26. Any location. Moderate salary. Good references. Box 6002, Water Works and Sewerage, 400 W. Madison St., Chicago, Ill.

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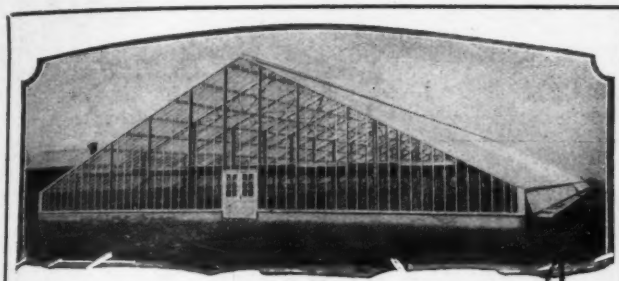

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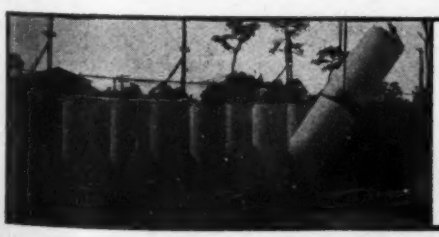

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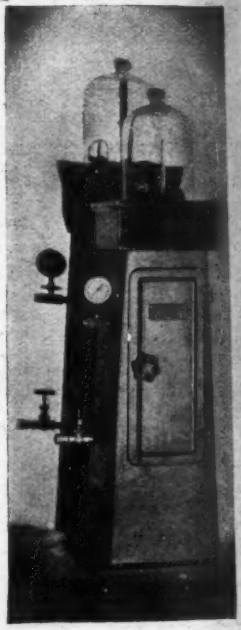

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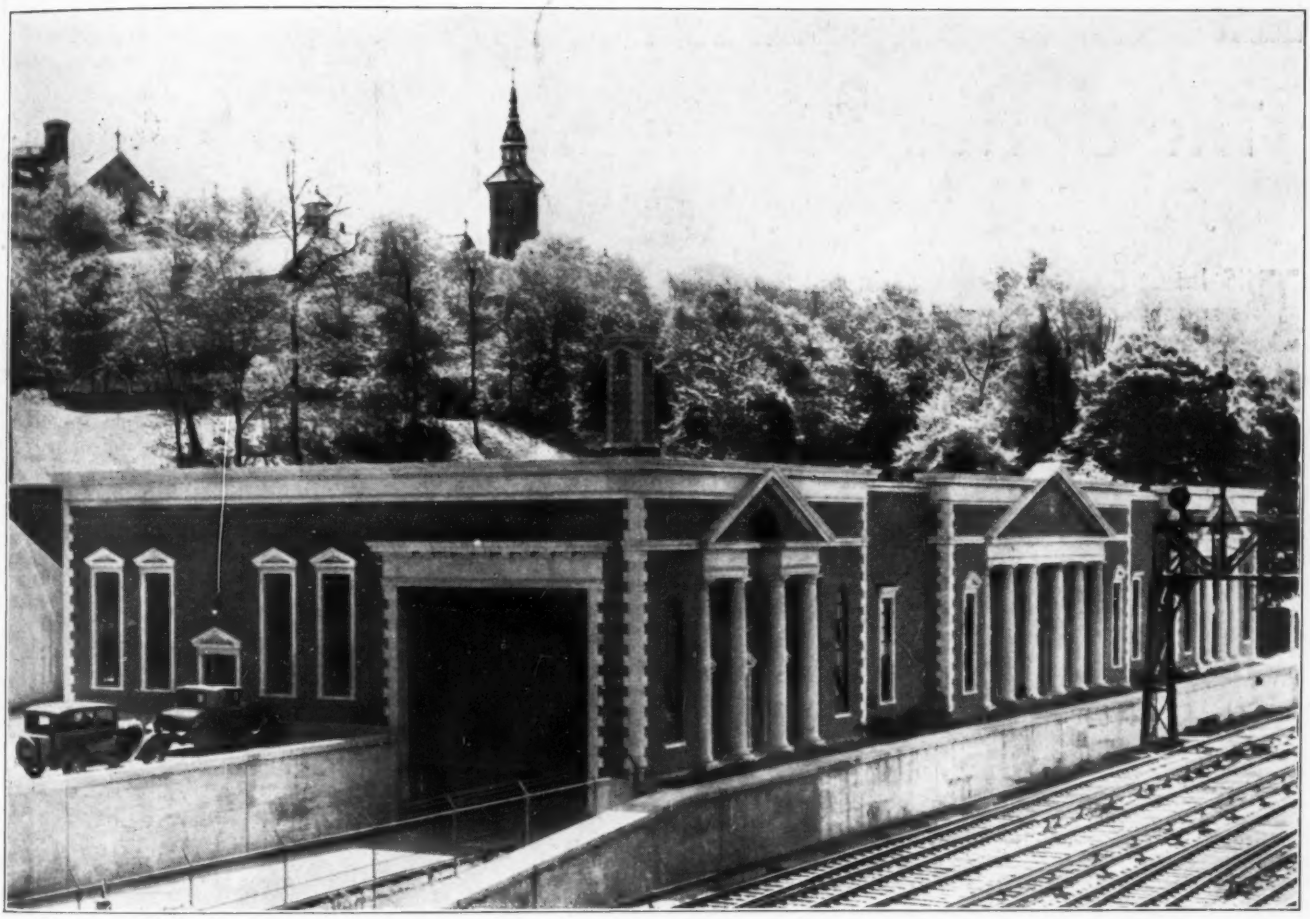

Sewage Treatment Works of Bronx Valley Project at South Yonkers, Westchester County, N. Y.

IN THIS ISSUE

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Practical Aspects of the Incineration of Sewage Screenings
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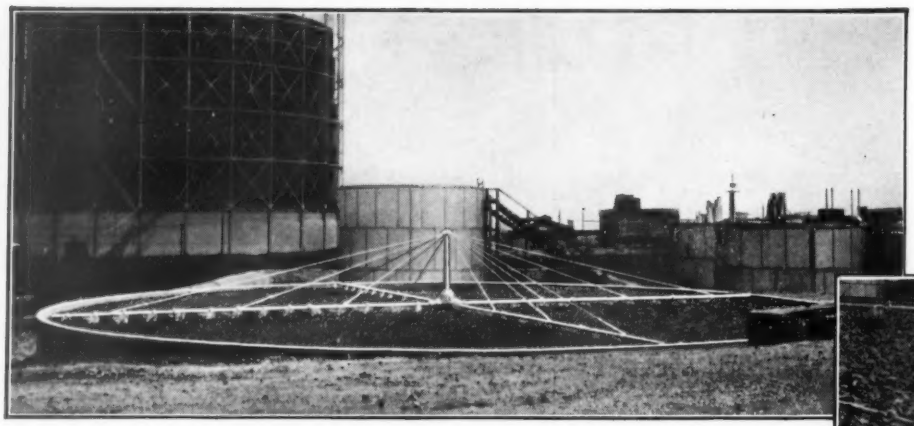

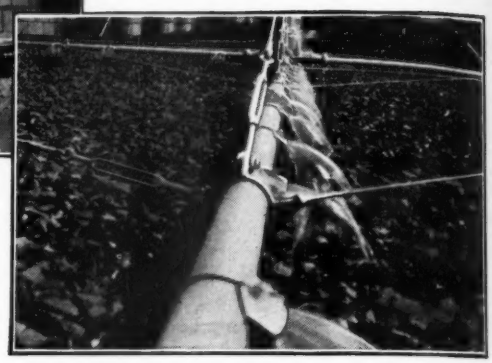

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